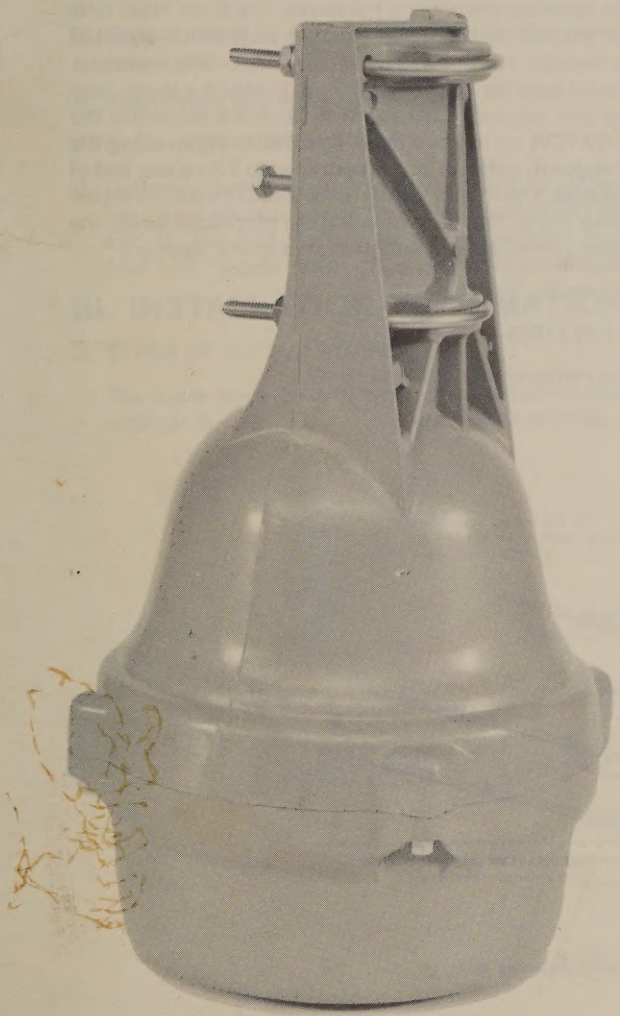
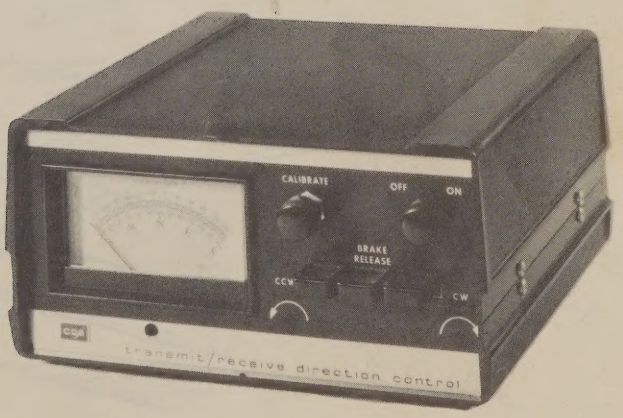
CDE HAM IV

ROTOR SYSTEM



OWNER'S MANUAL



THE HAM IV IS RECOMMENDED FOR ANTENNA ARRAYS NO LARGER THAN 15 SQUARE FEET OF WIND SURFACE AREA WHEN TOWER MOUNTED AND 7.5 SQUARE FEET OF ANTENNA WIND SURFACE AREA WHEN MAST MOUNTED USING THE LOWER MAST SUPPORT. FOR LARGER ANTENNAS, THE T²X HEAVY DUTY ROTOR IS RECOMMENDED.

CDE

CORNELL-DUBILIER ELECTRONICS

DIVISION OF FEDERAL PACIFIC ELECTRIC COMPANY

Rotor Department

Fuquay-Varina, North Carolina 27526

HAM IV

INSTALLATION AND OPERATION

I. CAUTIONS - READ CAREFULLY

A. Install **PROPERLY AND SAFELY.**

B. Towers, often the highest **METAL** parts in the vicinity, **REQUIRE EXTREME CAUTION** during erection and placement. **EXTREME CARE** must be taken during erection so that **METAL TOWERS AND BEAMS DO NOT CONTACT POWER LINES** even if the beams slip or rotate, towers fall or fracture, or metal wires blow in the wind, etc.

C. Metal towers or other position mechanisms **MUST BE PLACED SO THAT IF THEY FRACTURE OR BLOW OVER** in high winds, **THEY CANNOT CONTACT POWER LINES,** be a hazard to individuals, or endanger property.

D. When not mounted within a tower with a thrust bearing as shown in Figure 1, the rotator must be **DERATED.**

E. Metal towers must be **GROUNDED PROPERLY** at the **TOWER LOCATION BEFORE THE TOWER IS ERECTED.** This is to minimize electrical hazard and the possibility of lightning damage. Do not bury bare aluminum wires or stakes in the ground. Use copper ground stakes. The service entrance ground should be checked. The household 120 VAC convenience outlet should be the 3-prong type (grounded back to the service entrance).

F. The **CONTROL BOX** is not weather-proof and must be located in the house, ham shack or other **PROTECTED LOCATION.**

G. Read this manual fully **BEFORE PROCEEDING.**
The HAM IV rotor has been carefully designed and manufactured to give many years of trouble-free service when carefully and professionally installed. It consists of the strongest and best commercially available components. The design is based upon many years of experience by the Bell Rotor People - Cornell-Dublier Electronics in North Carolina.

II. COMPONENTS OF THE HAM IV

The HAM IV rotor consists of a bell type rotator, a metered control unit, and the necessary mounting hardware. The stock HAM IV is intended for in-tower mounting on the base plate which is part of the tower. However, in some instances, mast mounting is desired. The lower mast support kit, P/N 51467-10, contains a lower mast support and the necessary hardware to facilitate mounting the HAM IV ROTATOR on top of a mast. **CAUTION: When using the lower mast support, antenna size is restricted to 7.5 square feet of wind surface area.** The rotator unit must be wired to the control unit with an 8-wire cable. The control unit must be placed inside the house or other protected location. Included in the rotor are:

A. Owners manual P/N 51563-10

B. Rotator P/N 51569-10

C. Mounting Hardware Kit P/N 51415-10

D. Control unit P/N 51568-10

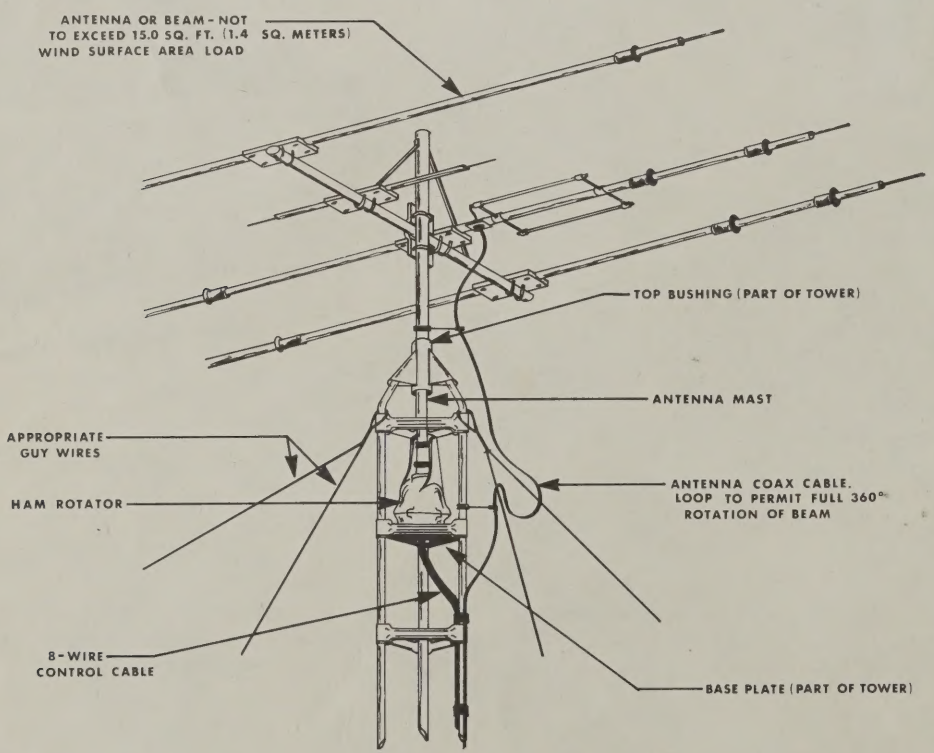

ANTENNA OR BEAM - NOT TO EXCEED 15.0 SQ. FT. (1.4 SQ. METERS) WIND SURFACE AREA LOAD
TOP BUSHING (PART OF TOWER)
ANTENNA MAST
APPROPRIATE GUY WIRES
HAM ROTATOR
ANTENNA COAX CABLE. LOOP TO PERMIT FULL 360° ROTATION OF BEAM
8-WIRE CONTROL CABLE
BASE PLATE (PART OF TOWER)

FIG. 1

Due to the wide variety of towers available, each installation will have different requirements. The gauge of the 8-wire cable to connect the control unit to the rotator **DEPENDS UPON THE DISTANCE BETWEEN THE ROTATOR AND CONTROL.** The longer the distance the larger the diameter of the wire required. Various antennas or beams require different installation methods. For this reason, the owner must procure the remainder of the components after checking their compatibility. In general, these will be:

A. The beam or antenna desired and a suitable antenna mast.

B. A tower or other mechanism to position the rotator and beam for safe and effective rotation (see **CAUTIONS**).

C. 8-wire cable to connect the control to the rotator. (See specifications).

D. Coaxial cable to connect the beam to the communications equipment.

E. Appropriate guy wires as required.

F. Grounding hardware.

G. Optional lower heavy duty Mast Support Kit must be procured if the owner elects to use an "outside" tower mount (see figures 2 and 3). The part number for the Lower Mast Support Kit is 51467-10. "Inside" tower (figure 1) is recommended.

III. INSTALLATION INFORMATION

A. TYPES OF INSTALLATIONS

There are three general types of installations (see figures 1 through 3).

1. **THE RECOMMENDED INSTALLATION** is an "inside" tower mount with a top bushing or bearing to provide support and resist high wind loads.
   When the rotator is properly mounted this way, it can be rotated to turn an antenna or beam of 15 square feet wind surface area. The wind loading during storms, the rotational inertia of the beam, and unbalanced weight are more important than the dead weight of the beam. It is important to minimize the height of the beam above the rotator to minimize the overturning force induced in a high wind (see "Unbalanced Weight" and "Wind Pressure").

2. An "outside" tower mount as shown (See Figure 2) is optional. The rotator is not as well protected but the installation is simpler. The owner must procure the Heavy Duty Lower Mast Support Kit, P/N 51467-10, to install as in figure 2 and derate to 7.5 square feet.

3. A telescoping or other-type mast as shown, (see figure 3) can also be used. This installation is similar to #2 above and requires the optional Heavy Duty Lower Mast Support Kit and must be derated to 7.5 square feet.

There are variations of the above falling generally into one of the above categories. For example, the rotator may be mounted lower in the tower than shown in Figure 1. In that case, more than one bushing or thrust bearing for the beam mast may be required and longer coast down time allowed in operation. These factors are interrelated and the components must be matched together.

B. UNBALANCED WEIGHT AND WIND PRESSURE

1. **UNBALANCED WEIGHT:** Weight should be as closely balanced as possible. Unbalanced weight creates a bending moment of force which is concentrated on the mast at the point where it is clamped to the rotor.

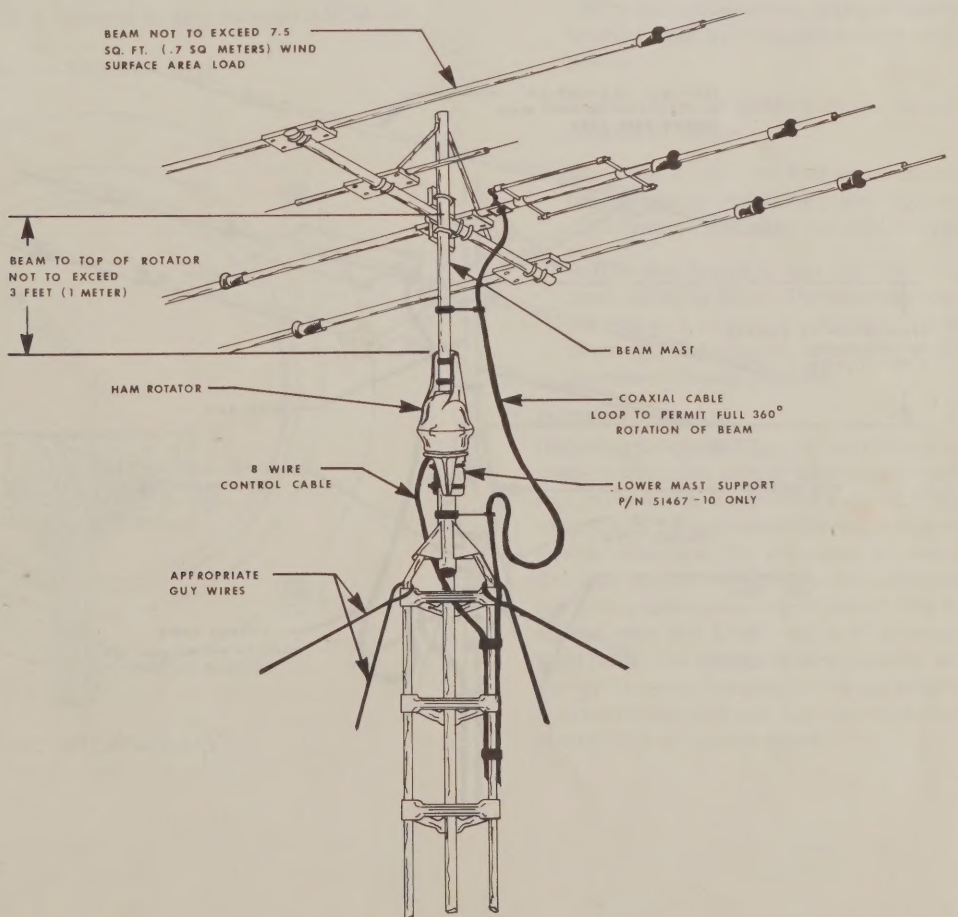

BEAM NOT TO EXCEED 7.5 SQ. FT. (.7 SQ METERS) WIND SURFACE AREA LOAD
BEAM TO TOP OF ROTATOR NOT TO EXCEED 3 FEET (1 METER)
BEAM MAST
HAM ROTATOR
COAXIAL CABLE LOOP TO PERMIT FULL 360° ROTATION OF BEAM
8 WIRE CONTROL CABLE
LOWER MAST SUPPORT P/N 51467-10 ONLY
APPROPRIATE GUY WIRES

FIG . 2

This moment tends to strain the mast at that point and also to bind the ball bearings by creating excessive downward pressure on one side and upward pressure on the other. Such unbalance places additional stress on the motor and gear train. Unblanced weight becomes critical as the distance from the antenna boom to the clamping point at the rotor is increased.

2. **WIND PRESSURE** against the boom and elements produces a bending force on the mast which can cause the same stresses as unbalanced weight. To strengthen the installation to withstand unbalanced weight and wind pressure the top mast should be as short and as strong as possible. In multiple arrays the heaviest should be closest to the rotator. In order to distribute the bending stress and prevent fracture of the mast, the HAM IV rotor includes a specially designed steel clamping plate to clamp the mast to the rotator.
   After procurring the type of tower or other positioning mechanisim of the owner's choice, the next step is to wire the rotator to the control box and check out its operation prior to installation.

IV WIRING AND CHECK - OUT

A preliminary operation check should be made prior to installation. We recommend the following procedure:

A. Decide the wire guage (size) required and procure the number of feet of the proper cable - see table, on page 11.

B. Strip and tin ⅜" on both ends (16 wires) after removing about 4 inches of the jacket. Tinning can be accomplished, after twisting the strands together, with an ordinary soldering iron and radio solder, being careful not to melt the insulation.

C. With the control unit and the rotator on the work table, connect the cable between the rotator and control unit using the full length of cable that will be used in the installation. **IT IS IMPORTANT THAT #1 TERMINAL ON THE ROTATOR IS CONNECTED TO THE #1 TERMINAL ON THE CONTROL UNIT AND SO ON. NOTE:** The specifications call for **HEAVIER** gauge wire in two locations. **LEADS** #1 and #2 must be **HEAVIER GAUGE and less total lead resistance** (See specifications Page 11). Wire the control to the rotator as shown in figures 4 and 5.
   CAUTION - - SHORTS BETWEEN TERMINALS OR GROUNDED LEADS MAY DAMAGE THE ROTOR.

D. With the rotator sitting in the upright position and connected to the control unit, by the eight (8) wire cable, plug the control unit power cord into a 120 VAC 50/60 Hz wall receptacle.

E. Turn the power switch on. The meter should be illuminated.

F. Depress the "Brake Release" (center) lever, then release it. An audible click should be heard in the rotator. This is the solenoid operating the brake wedge.

G. Depress the "Brake Release" (Center) lever, hold it, and simultaneously depress the CCW direction switch (left). The rotator should turn CCW (looking from the top). This is S-E-N-W-S. Release the CCW direction switch; the rotator will coast down and stop. Now release the brake switch. The rotator is now locked into position.

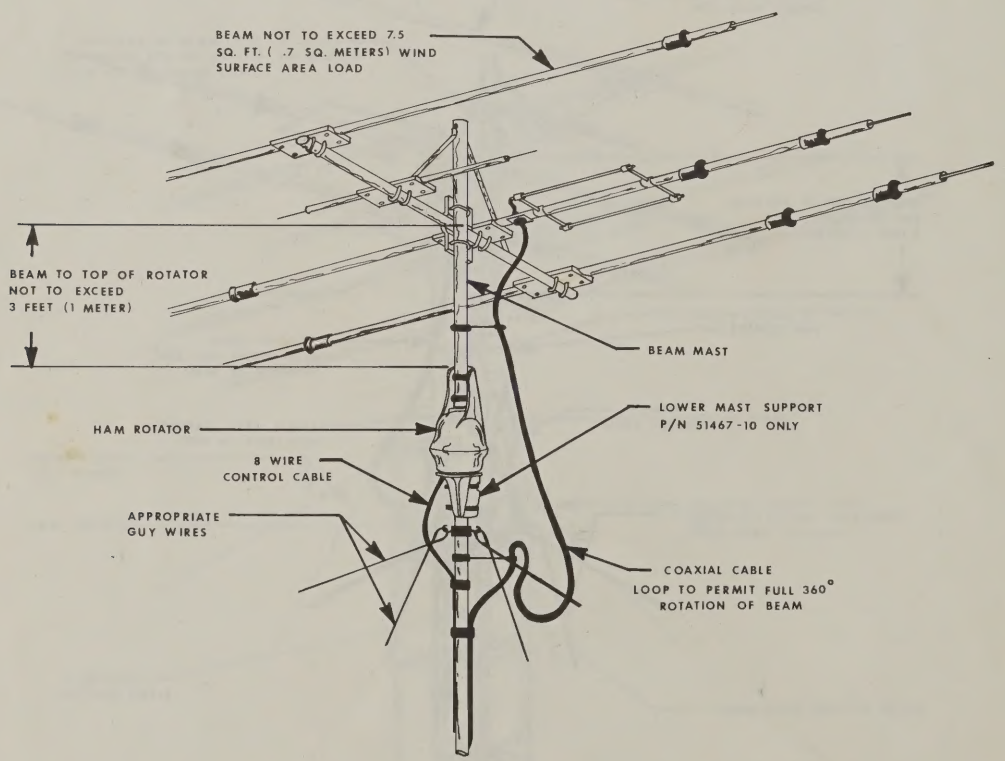

BEAM NOT TO EXCEED 7.5 SQ. FT. (.7 SQ. METERS) WIND SURFACE AREA LOAD
BEAM TO TOP OF ROTATOR NOT TO EXCEED 3 FEET (1 METER)
BEAM MAST
LOWER MAST SUPPORT P/N 51467-10 ONLY
HAM ROTATOR
8 WIRE CONTROL CABLE
APPROPRIATE GUY WIRES
COAXIAL CABLE LOOP TO PERMIT FULL 360° ROTATION OF BEAM

FIG. 3

H. Repeat the above for CW direction by depressing the brake switch first, then the CW direction switch (Right).
CAUTION: It is best to release the direction switch just prior to the end of rotation (extreme CW or CCW position) in order not to cause undue stress on the stop arm and/or the gears.

I. Return the rotator to full CW position.

V. MOUNTING THE ROTATOR

A. **INSIDE TOWER.** The rotator is mounted inside a tower (see figure 1) to the flat tower plate by means of four bolts furnished in the hardware kit. Use the following procedure:

1. Locate the rotator in the tower directly under the bushing. Note that the tower plate must be cut out to allow the connecting 8 wire cable to pass through the plate.
2. Reattach the wires in the same manner as used in the trial assembly and secure the wires to the tower in such a manner that the wires will not be strained.
3. The rotator is attached to the tower plate by means of 4 bolts and lockwashers (see figure 6). The flat tower plate must be drilled in four places using the template provided with this manual unless the tower plate is already properly drilled.
4. Tighten the 4 bolts but not to final tightness. Observe how the rotator turns. It must rotate in such a manner as to turn the mast concentrically to the top bushing.
5. Trial assemble the mast to the top of the rotator using the U-bolts, nuts, and lock washers through the rotator and clamp plate as shown in Figure 6. The maximum mast diameter that may be used is 2 1/16" O.D. We recommend 1½" nominal **STEEL PIPE** with 1.9" O.D. in standard wall thickness of .145". For stacked arrays or very large beams, we recommend extra heavy duty wall thickness .200". Both steel pipes can be purchased to specification ASTM-120.

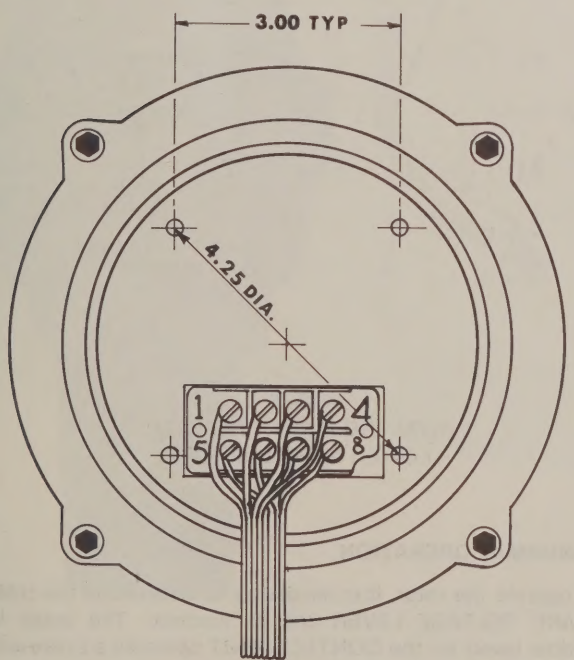


FIG. 4 ROTATOR WIRING

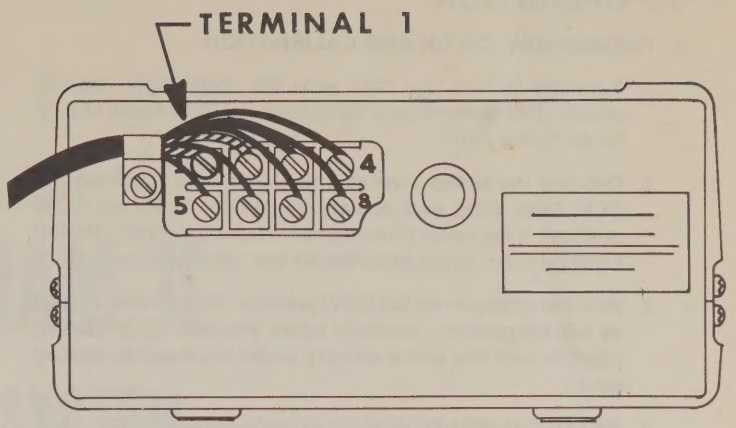


FIG. 5: CONTROL UNIT WIRING

6. If the rotator, top bushing, and mast are properly aligned, there should be unrestricted rotation thru a full 360°. If not, the rotator may have to be moved slightly on the flat plate and/or the mast may have to be shimmed using shims between the mast and the V-shaped bell rotator casting. If a high quality bearing is used in the top of the tower (RECOMMENDED) the shimming procedure must be done more carefully as closer tolerances are required. **IT IS IMPORTANT THAT THE ROTATOR NOT TRY TO TURN THE MAST ECCENTRICALLY WITH THE TOP BUSHING OR BEARING.** The geometry is such that a mast of 52 mm (2.062 inches) will be exactly centered. For each 1.6 mm (.0625 inches) less mast diameter used, .8 mm (.031 inches) of shim must be wrapped around the mast of the clamping points.
7. Tighten the four bolts carefully - to approximately 100 inch pounds of torque.
8. Insert the ¼ - 20 x 1¼" bolt with a locking nut into the center tapped hole in the clamp plate. Tighten down to assure that the antenna mast does not turn in the upper mast support.
9. Return the rotator to the full CW "S" position. Mount the beam pointing South. The coaxial cable should be looped as per Figure 1, in such a manner that it will not foul or tangle when the beam turns around in a circle to the full 360° counterclockwise position.

B. **OUTSIDE TOWER**
Referring to figures 2,3, and 7, an outside tower or pole mount is made in the same manner except that the rotator is fastened by four bolts to the lower mast support, P/N 51467-10. Since the eccentricity of the rotator turning in reference to the tower is no longer important, the shimming procedure is not necessary. The four screws must be torqued to the same specification, and the 8-wire cable securely fastened. The lower mast should be pinned with the 5/16" - 18 x 4" bolt as shown in Figure 7. **CAUTION:** The rotator is designed for vertical operation with the bell shaped housing in the up position. Water and other contamination will get into the motor unit if it is mounted horizontally or upside down.

VI. OPERATION

A. PRELIMINARY CHECK AND CALIBRATION

1. Turn the control box "on" with the upper right "on-off" switch. The meter should be lighted and the needle should be on to the right.
2. Depress the brake lever (Center) and hold. Depress the CCW lever (left) and operate the rotator to its full CCW position. If the meter does not move from the right to the left hand position, press and release the "calibrate" switch.
3. With the rotator in its full CCW position, if the meter is not at its full left position, carefully adjust the zero (CCW South) position with the screw directly under the meter to exactly South.
4. **METER CALIBRATION** of the extreme full scale (right hand or clockwise South) can be accomplished at any time without disturbing the rotator using the following procedure:

a. With the control unit "on", push in and release the "calibrate" knob.

b. The meter should now indicate full scale to the right. If it does not, turn the calibrate knob until it does.

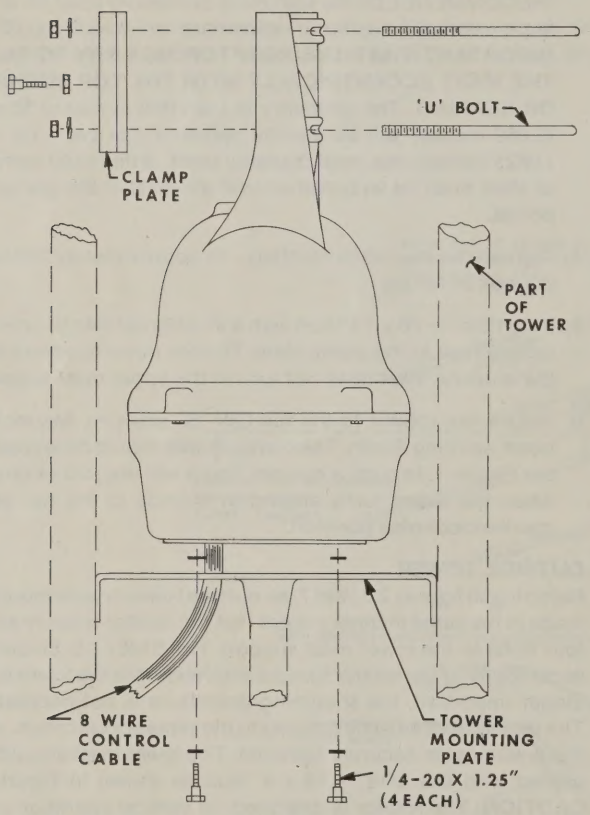


FIG. 6
ROTATOR MOUNTING
IN A TOWER

c. Without turning the knob, push it in and release it. The right scale is now fully calibrated to adjust for minor variations in components values. Do not, then, turn the knob, even in the "push-off" position because to do so will require that it again be recalibrated.

5. Return rotator to its full CW end of rotation.

When the control unit is turned "off", the meter needle will fall to the left "S" position and return to indicate the rotor position as soon as the control unit is turned "on" again. It will not damage the unit to leave it turned "on" for extended periods.

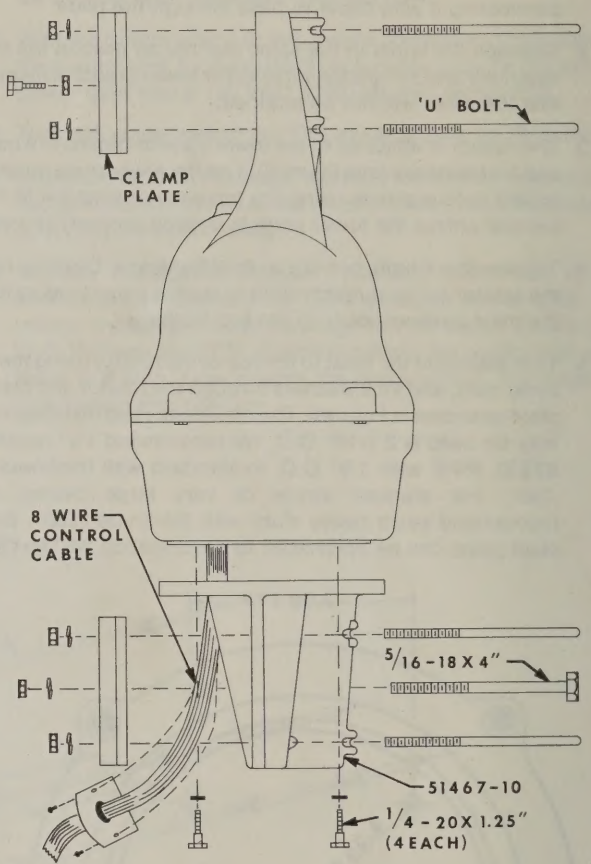


FIG. 7
ROTATOR MOUNTING WITH
LOWER MAST SUPPORT

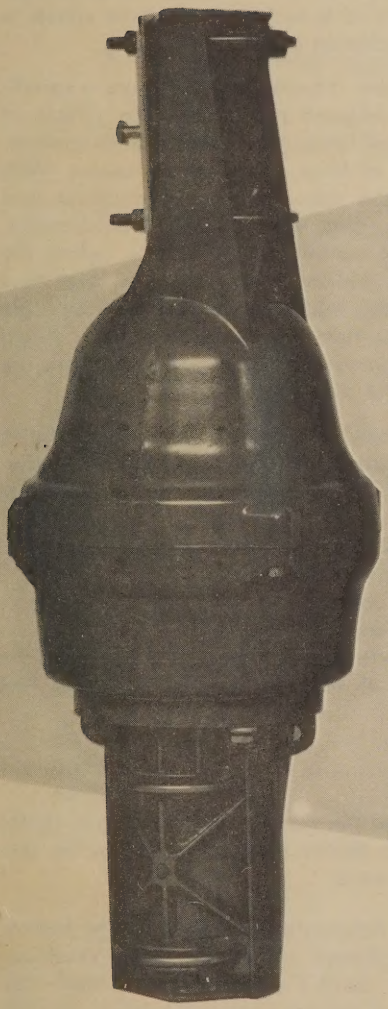
B. NORMAL OPERATION

To operate the rotor, it is necessary to understand the HAM IV BRAKE RELEASE LEVER and its function. The brake lever (middle lever) on the CONTROL UNIT operates a brake wedge mechanism in the rotator which locks the rotator into position mechanically. The rotator cannot turn unless the wedge is retracted by depressing the middle lever. The normal operation is as follows:

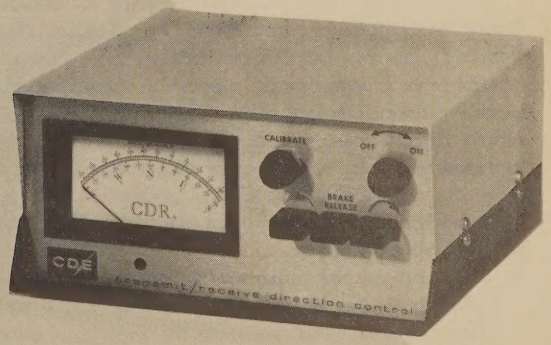
1. Retract the brake wedge by holding down the "Brake Release", middle lever.

CLASS 252-50

CDE HAM II
ROTOR SYSTEM



Owner's Manual



Telex Comm. Inc. 9600 Aldrich Ave S. Minneapolis MN 55420

CDE
CORNELL-DUBILIER ELECTRONICS
DIVISION OF FEDERAL PACIFIC ELECTRIC COMPANY
Rotor Department 402-465-7021
Fuquay-Varina, North Carolina 27526

OWNER'S MANUAL - HAM II

Foreword On the following pages, you will find information obtained from the Engineering Staff where the Ham Rotors are built, the Service Engineering Group, and from amateurs who have Ham Rotors installed. No attempt has been made to detail every possible installation or suggest every maintenance procedure that may be necessary to cover many years of operation.

Please feel free to communicate with us at any time that we may be of assistance. Write to:

CORNELL-DUBILIER ELECTRONICS
Division of Federal Pacific Electric Company
CDR Rotor Department
118 E. Jones Street
Fuquay-Varina, North Carolina 27526

General The Ham II Rotor System is designed to accomodate amateur antennas with a maximum of 7.5 square feet of wind area. The Ham II provides a full 360° range of rotation and a meter scale read out for accurate position indication.

The Ham II Rotator is built along the general lines of the original CDE Bell type rotors. The weight of the upper mast and the antenna is carried directly in line with the lower supporting mast. The motor, radial and thrust bearings, electrically operated wedge brake, gear train, and indicating sensor are built into the elongated bell shaped cast aluminum housing.

The Ham II wedge brake system is operated independent of the clockwise and counterclockwise directional controls. However, the directional controls will not function until the brake is released.

Pre-Installation Check It is recommended that a preliminary operational check be made on the system prior to actual installation. Check each item of the system for physical damage due to shipping. The Ham II system consists of a control unit, a bell rotator unit, a lower mast support, a hardware package and a service manual. If any of these items are missing or damaged, return the complete system to your dealer or the factory for replacement. Sales receipt must accompany such a return.

After the physical check of the equipment, set up the control unit and the Bell rotator for an electrical check. We recommend the following procedure:

1. Measure out the maximum 8-wire control cable required for your particular installation. (See spec table) strip the insulation from all wires, separate the individual wires back about 2-3 inches, and tightly twist the stranded ends. Soldering these ends improves manageability.
2. With the control unit and the rotator on the work table, connect the cable between the two units. Make sure wires 1, 2, 3, 4, 5, 6, 7, & 8 on the control unit are to 1, 2, 3, 4, 5, 6, 7, & 8 on the rotator, respectively.
   CAUTION: No loose strands of wire should touch adjacent terminals or other metal parts of the units.
3. With the rotator sitting in the upright position and connected to the control unit, by the eight (8) wire cable, plug the control unit power cord into a convenience 115 VAC 50/60 Hz wall socket.
4. Turn the power switch on. The meter should be illuminated.
5. Depress the brake release (center) lever then release it. An audible click should be heard in the rotator. This is the solinoid operating the wedge brake.
6. Depress the brake release, hold, and simultaneously depress the clockwise direction switch (right). The rotator should turn clockwise (looking from top). This is S-W-N-E-S. Release the direction switch; rotator will coast down and stop. Now release the brake. The rotator is now locked into position.

   CAUTION: It is best to release the direction switch, and brake switch prior to end of rotation (extreme clockwise or counterclockwise position) in order not to damage the stop arm and/or the gears.

The rotator is now stopped and the brake is engaged. To turn the rotator counterclockwise, release the brake, hold and simultaneously depress the counterclockwise switch (left). The rotator will turn counterclockwise. This is S-E-N-W-S. After rotator has stopped, release the brake.

Prior to actual installation, check the calibration to familiarize yourself with this procedure. It is best done while the system is still set up for the Pre-installation check.

In Service Operation The Ham II brake release feature is specifically designed to decrease the effects of torsional forces caused by rapid de-acceleration and instant stopping of large antennas and beams. With practice, smooth and precise stops can be made without over stressing the rotator, tower, antenna or supporting mechanisms. By releasing the direction control switch slightly before the point of intended antenna position, letting the unit coast to a full stop, then releasing the brake, no snap action stops are required. This feature of the Ham II, when properly used, should prolong the life of your rotor system as the major stresses are greatly decreased.

Service Cornell-Dubilier maintains a modern well staffed repair department for all CDE antenna rotors. If service is required, the unit should be packed securely and sent prepaid to:

Cornell-Dubilier Electronics
Rotor Service Department
118 East Jones Street
Fuquay-Varina, N. C. 27526

For units that are in warranty, no charge will be made for repair. If the unit is out of warranty, the following flat rate charges apply:

Control box only	$12.00
Rotator only	$15.00
Complete unit	$25.00

A check or money order for the amount indicated above should be included. The flat rate charge includes rebuilding the unit and replacing of defective parts.

Meter Calibration Rotators are shipped from the factory stopped in the full counter clockwise (South) position. To calibrate the meter, have the rotator full counter clockwise position, on - off switch "off" and use the zero - center screw to line the needle on the left hand "S" limit. With the on - off switch in the "on" position, push in the calibrate knob. The calibrate knob is a push to calibrate type. Locate the needle on the right hand "S" limit. This meter calibration can be performed any time it is desired to check the accuracy. When power is off, the needle will fall to the left hand "S". When power is on, the needle will indicate the antenna position. The zener regulated meter supply will minimize reading variations due to line voltage fluctuations.

AK-121 TOWER MOUNT KIT

This kit was made available to provide an easy method of mounting the rotor directly to the antenna tower and provide clearance for the rotor cable.

TO INSTALL:

1. Align tower mount plate in center of tower top plate.
2. Center punch location of the four mounting holes.
3. Drill the four mounting holes using a 17/64 drill.
4. Mount tower mount plate on tower top plate--plate side down.
5. Connect cable to rotor.
6. Place rotor on top of spacers.
7. Insert (4) SM-120-2 hex head screws through the plates into the rotor and tighten down.

Rotor Installation The Ham II rotor is engineered to handle relatively heavy antennas including multi-band arrays having traps at the extreme of the elements. Long and trouble free performance of the system depends on making the installation to properly handle the stresses involved. **CAUTION:** THE ROTATOR IS DESIGNED FOR VERTICAL OPERATION WITH THE BELL SHAPED HOUSING IN THE UP POSITION. Water and other contamination will get into the motor unit if mounted horizontal or up-side-down.

Balanced Weight produces only down-thrust on the rotor. With 98 ball bearings operating in accurately machined races, the rotor is capable of handling as much as a thousand pounds downward pressure in line with the axis of rotation.

Unbalanced Weight creates a bending moment of force which is concentrated on the mast at the point where it is clamped to the top of the rotor. This moment tends to strain the mast at that point and also to bind the ball bearings by creating excessive downward pressure on one side and upward pressure on the other. Such unbalance places additional stresses on the motor and gear train. Unbalanced weight becomes critical as the distance from the antenna boom to the clamping point at the rotor is increased.

Wind Pressure against the boom and elements usually produces a bending force on the mast which causes the same stresses as unbalanced weight. To strengthen the installation to withstand unbalanced weight and wind pressure, the top mast should be as short as possible. In multiple arrays the heaviest sections should be closest to the rotator. In order to distribute the binding stress and prevent fracture of the mast, the HAM rotor includes two long, heavy, specially designed steel clamping plates. These are grooved to grip the mast securely. It is recommended that the mast be reinforced in the area where it is clamped by driving a hardwood dowel of proper size into the end of the mast.

Start-Stop Torsion Torsional or twisting forces must be given special considerations when using the Ham rotor with large antennas and beams. The acceleration of the antenna array is gradual as the motor picks up the load. However, if the brake release switch is not used properly, stopping will be instantaneous, therefore, subjecting the antenna, rotator, and support system to undue strain. To alleviate instantaneous stops, always release the directional switch, CW or CCW, prior to the intended antenna direction, let the unit coast down to a stop, then release the brake. When the brake wedge is engaged into the groove of the outer casting, the top and bottom of the masts are locked rigidly together. It is absolutely essential that all mechanical assemblies making up the antenna array be solidly clamped so that no slipping occurs under heavy stop/start/wind load conditions.

Torsional Guying of Tower Average height, well built towers, properly erected, carrying average antennas, are able to absorb the heavy twisting strain at the moment of stopping. Where the antenna is large or heavy, or the tower is tall or of light weight construction, a torsion bar or sway brace (as shown in Fig. 2 on the next page) should be rigidly attached near the top of the tower. Such an arrangement allows the double guy wires to absorb the shock of stopping, which would otherwise tend only to twist the tower on its base.

Mechanical Description The motor drives a train of stainless steel spur and pinion speed reduction gears which in turn drive the ring gear. The ring gear drives the bell shaped upper mast support, into which the antenna mast is mounted in rigid central alignment.

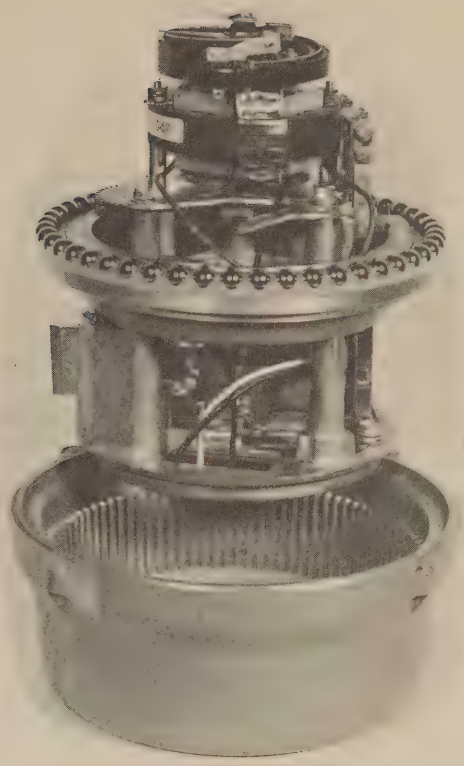


Fig. 1

A boss is cast on the under side and in the center of the cavity of the upper mast support, which engages the serrated edge of the potentiometer arm which is mounted on the top of the inner mechanism.

Maximum support and low frictional loss between the rotating upper mast support and the inner mechanism is assured by the use of two groups of 49 steel balls each riding in the bearing races between the two assemblies, and held in special nylon retainers.

Mechanical stops along with electrical limit switches are built into the rotor mechanism to provide accurate and complete 360 degree rotation.

The brake assembly is released by a 24 volt AC solenoid, the plunger of which is mechanically attached to the wedge. When the wedge is positioned for braking, a cam latch locks the wedge in the teeth of the lower housing. To release the brake, the solenoid is energized. This unlocks the latch automatically and retracts the wedge from the gear teeth in the housing.

Circuit Description Two transformers are mounted in the control unit. The power transformer supplies approximately 30 VAC for releasing the brake and operating the motor when control levers are depressed. Overheating of the transformer from prolonged operation or possible short circuit is prevented by a thermal cut-out switch in the primary winding.

The motor is a two-phase device with the first winding being supplied AC direct from the transformer while the second has a 120-140 MFD. capacitor in series in order to shift the phase and provide forward rotational torque. To reverse, the capacitor is switched in series with the first winding, while the second is directly supplied from the transformer.

The solenoid which releases the brake operates from the same transformer that supplies power to the motor.

The meter transformer is energized as the on-off control is switched to the "on" position. This illuminates the meter dial

and the meter indicates the position of the antenna. 13 VDC is supplied to the 500 OHM potentiometer in the rotator through a zener regulated supply.

The meter is a high quality DC instrument requiring 1 MA for full scale deflection. It is connected with plus side through the 10 K multiplier to the plus side of supply and potentiometer, which is protected by a 1/8 AMP fast blow fuse. The meter circuit is completed through the 5000 OHM calibrate control and operate/calibrate switch to ground. The operate/calibrate control is located on front panel. With the zener controlled supply the 5K calibrate control will be set at approximately 3000 OHMS which will give 13,000 OHMS in series with meter to allow for 1 MA deflection at full scale.

Two electrical limit switches in the rotator cut the motor power just before the rotation reaches the extremes. A fuse, located on rear panel is also included on one side of the AC power line.

CONSTRUCTION NOTES

A. Tape cables securely to mast.
B. Provide slack for rotation and drip loop.
C. Anchor securely to standoff to prevent strain on connectors and slipping of cable.

SUGGESTED MATERIALS

1. Make from 1½ x 1 x ⅛ angle iron.
2. Use cadmium plated harware, 5/16" or ⅜" bolts.
3. Use standard ¼" bolts.
4. Make spacers from ¼" galv. pipe.
5. Copper tubing over guys, crimp and tape.
6. Wooden spacer to keep bracket level.
7. Double standoff.
8. Single standoff.

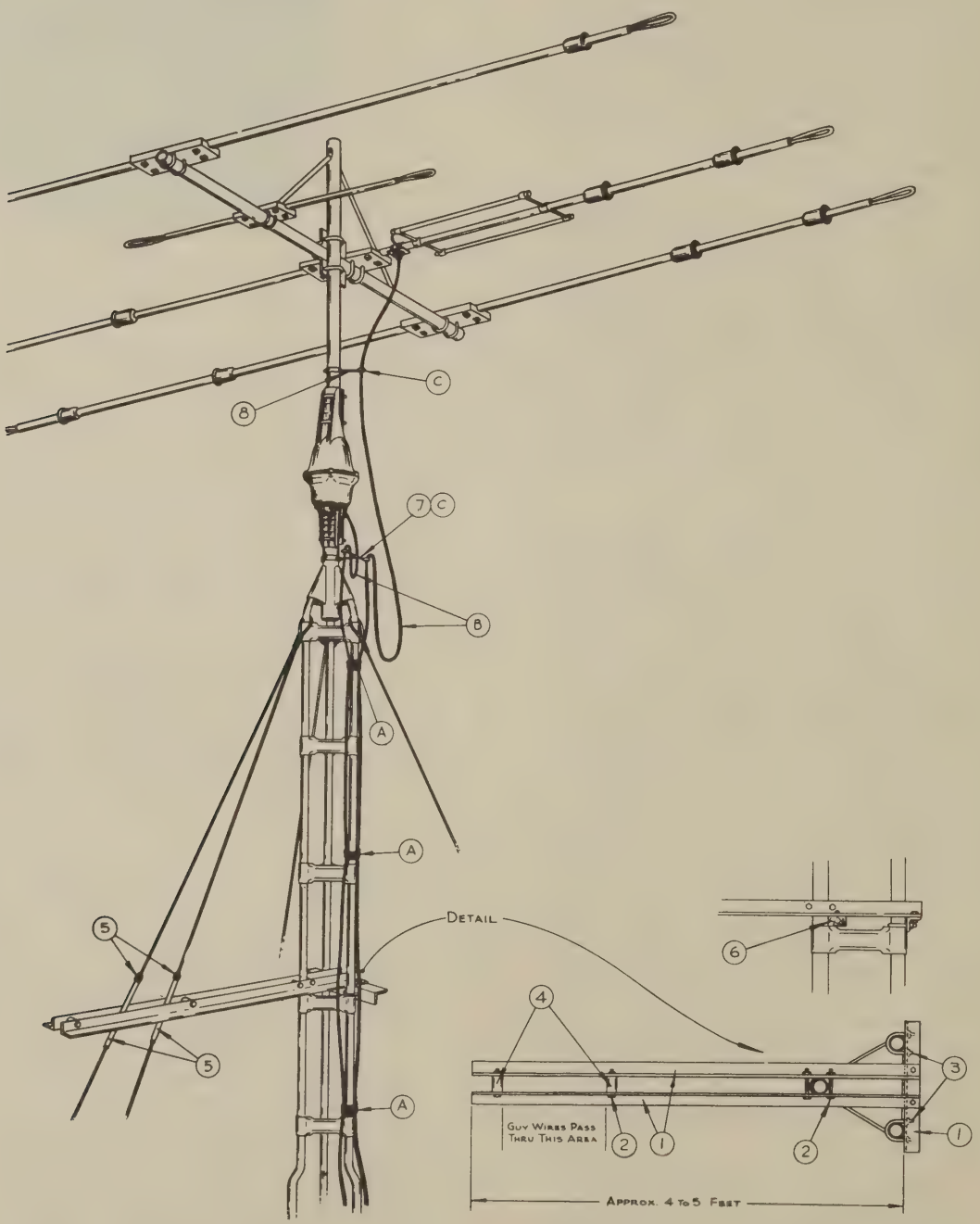


Fig. 2—Top Tower Installation with Torsion Bar

Checking Control Unit

To check the control unit, plng line cord into 115 volt AC power. With no connections to terminals turn the on-off switch to on position, the meter light will illuminate. Meter needle will remain on left hand "S".

To check the power circuit connect an AC voltmeter between terminals No. 1 and No. 2 on the rear panel and see that approximately 30 volts is indicated when brake release lever is depressed. Connect meter leads between terminals No. 1 and No. 5 and read approximately 30 volts with brake release lever and clockwise lever depressed. Now connect meter leads between terminals No. 1 and No. 6 and read approximately 30 volts with brake release lever and counterclockwise lever depressed.

Checking Rotator

Connect all 8 terminals of the control box to the corresponding 8 terminals of the rotor using the coil of cable obtained for the installation. The 2 heavy wires in the cable should be used for terminals 1 and 2 (Refer to Schematic). CAUTION — SHORTS BETWEEN TERMINALS OR GROUNDED LEADS MAY BURN UP THE POT STRIP IN ROTATOR.

With the rotor in an upright position without the lower mast support assembled, operate rotator by means of control unit lever in both directions. The operation of control unit lever on and off, releases the brake mechanism in rotator. This is audible to the operator.

Checking Rotator From the Ground

One may possibly avoid bringing the rotator down from the mast by making electrical checks from the position of the control box. This is done by disconnecting the eight wires from the screw terminals and tagging them carefully No. 1 through No. 8 to correspond with the terminal numbers from which they are removed. From the schematic diagram it is apparent that the resistance of the lead wires will be added to the resistance of the motor windings and potentiometer strip in making the resistance checks.

Leads No. 1 and No. 2 of No. 18 AWG have approximately 0.64 OHM resistance per 100 feet and leads No. 3 through No. 8 of No. 22 AWG have approximately 1.6 OHMS resistance per 100 feet. Use a low resistance ohmmeter to check the values shown in table one to an accuracy of 10 percent after adding the resistance of the leads involved.

To Check	Read Resistance	Between Terminsl
Brake Solenoid	.75 ohms + leads	1-2
½ Motor Winding	2.5 ohms + leads	1-8
½ Motor Winding	2.5 ohms + leads	1-4
½ Motor + Switch	2.5 ohms + leads	1-5
½ Motor + Switch	2.5 ohms + leads	1-6
Entire Motor	5 ohms + leads	8-4
Right Limit Switch	0 ohms + leads	8-5
Left Limit Switch	0 ohms + leads	4-6
Entire Pot Switch	500 ohms	3-7
Pot Arm to + End	0 to 500 ohms	3-1
Pot Arm to — End	0 to 500 ohms	1-7

Table 1

Servicing the Control Unit

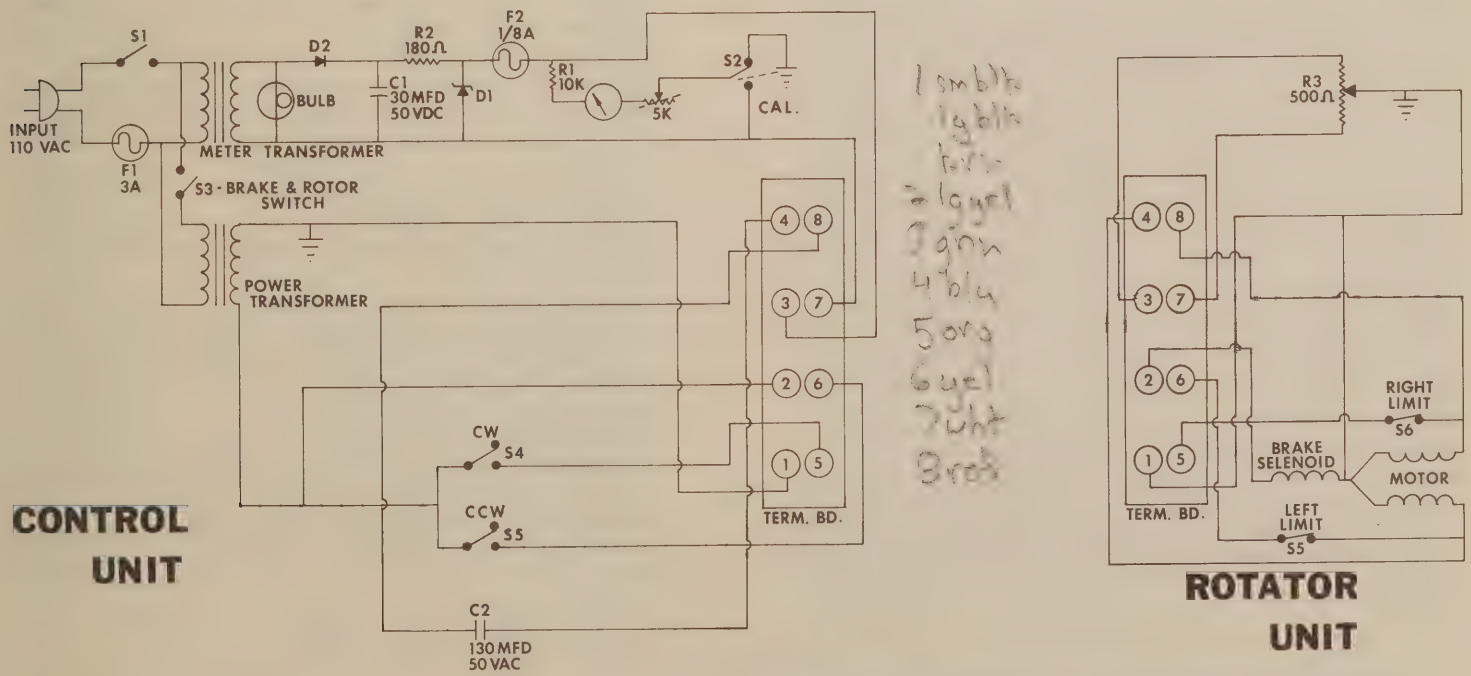
Disconnect the AC power source and remove the eight wire control cable. Be sure to tag each wire with the corresponding terminal number.

The control box can be checked without removing the cover by using a volt-ohmeter to check values across terminals. Resistance across terminals No. 1-2 should read .4 Ohms. Read same value across terminals No. 1-5 with clockwise switch lever (right-hand) depressed and across terminals No. 1-6 with counter clockwise switch lever (left-hand) depressed. Resistance across input line cord with on-off switch in the "on" position and the brake lever depressed should read 3.8 Ohms.

With power cord connected and on-off switch in the "on" position and brake release lever depressed read approximately 30 VAC across terminals No. 1-2. With on-off switch in "on" position read 13 ± 10% VDC across terminals No. 3-7.

The electrolytic motor capacitor must be of proper value to give adequate motor torque. If a new capacitor is not available for check by substitution, a quite reliable check may be made using the power transformer in the control box and an auxiliary 1 Ohm 10 Watt resistor.

To make this capacitor check, remove cable from terminals and tie terminal No. 2 to No. 4. Connect one end of resistor to No. 1 and the other end to No. 8. Turn off-on switch to "on" position and depress brake release lever. If capacitor is ok it will draw sufficient current to cause a voltage drop of 1.4 to 1.6 volts to be present across the resistor. Measure with an AC voltmeter.



NOTE: USE # 18 WIRES FOR TERMINALS 1 & 2.

Fig 3

Disassembly of Rotator

1. Remove the bottom mast support to permit the rotator to be set on a flat bench.
2. Remove four screws and carefully raise top casting to expose potentiometer and drive mechanism.
3. Carefully remove upper ball retaining ring. Keep it circular, and lay it on clean paper.
4. Inspect inside of top housing for small scratches or burned spots on the ribs. These are an indication that a switch blade or connection is rubbing during rotation. See that the pot strip is clean and not burned at either end. See that pot body is secure and that pot arm is clean at the point of contact. Use only fine rouge cloth to polish contact arm. Check limit switch to see if wires are secure and insulation is undamaged. Contacts should be clean. Check for 1/32" clearence between switch blades and motor—particularly alongside of lockwasher under motor fastening. Greater clearance gets switch too close to top bell housing ribs.
5. If the drive ring happens to be near end of rotation, operate the top spur gear to rotate the mechanical stop on the drive ring away from the area of the limit switch. See that the mechanical stop lever (which is positoned between the two limit switches) will open each electrical contact before it hits the corresponding mechanical stop. Also see that the stop lever has not been deformed and that the electrical contacts are clean and uncorroded.
6. Rotate the top spur gear several revolutions to determine that the motor and its bearings are operating freely. Look for broken teeth in any of the gears.
7. Lift the motor and brake mechanism out of the brake housing. Carefully remove the lower ball bearing retainer and place it on a clean piece of paper.
8. Remove the drive ring gear from the base housing. This is accomplished by first pulling up on the side opposite the gear train. Then raise the entire ring slightly upward with the side away from the gear train higher so that it will slide out from the under the gears. Examine closely for evidence of broken or worn teeth.
9. Examine the inside of the screw terminal strip to see that there is proper clearance between the solid lugs and frame and that there are no faults in the insulation. Pay particular attention to the insulation at the point where the wires are held in metal clips.
10. Examine the teeth in the brake casting.
11. To separate motor, pot, and gear assembly from the brake assembly, unsolder the solenoid leads from terminals 1 and 2. Remove screws holding terminal board to casting. Then remove four large screws in the base. Be careful to clear wires and terminal strip through opening.
12. The latch mechanism, accessible only after step 11 disassembly, slides down into grooves in the casting and provides the top bearing surface for the brake wedge. The latch itself, which is held down by the compression springs, should prevent the brake wedge from being pushed into the casting from the outside. When the plunger is pushed into the solenoid by pressure applied on the latch pin, where the retracting springs are attached, the wedge is withdrawn and may then be pushed clear into the casting.
13. To remove potentiometer, pry the spring fasteners with a sharp instrument. Remove hex nuts. Unsolder leads. Mounting studs are welded to the motor frame. Be sure that the pot strip is clean and that pot arm is not corroded. Use only fine rouge cloth as an abrasive. In replacing the pot be sure the connections are on the side which overhangs the motor.
14. To replace the motor, first remove the pot per Paragraph 13, then unsolder black motor lead from screw terminal 1, the red lead from inside left limit switch lug, and the blue lead from inside right limit switch lug. Fastenings holding motor on studs may then be removed and the motor pulled up and out. In replacing a motor, be sure to see that the round hole in the motor is next to the limit switch. Use a double lock nut on this stud near the limit switch, to provide clearance with the leads. Use special internal-external lockwasher over the stud that works in the slotted hole in the motor. Be sure that the pinion is snug against the spur gear before tightening this fastening over the slot.
15. When it is necessary to closely inspect or replace gears, it is possible to remove motor, limit switch, pot, and terminal strip without unsoldering more than the solenoid leads from terminals 1 and 2. Remove motor fastenings from the mounting studs. Work motor up and out, exercising care in pulling leads and terminal strip through the window in the gear housing. Remove plate to expose gears. Carefully note positions for proper replacement.

Final Reassembly of Rotator

It is assumed in the following instructions that the brake mechanism is assembled and operative. The motor and gear train along with potentiometer and limit switch are likewise assembled and wired and operative.

It is not likely that the brake wedge will be exactly positioned in relation to the teeth in the brake housing to permit proper assembly unless the brake mechanism is retracted. For this reason it is necessary to operate the brake mechanism electrically during step 8 of the assembly of the rotator unit.

1. See that a small amount of low temperature, high quality, light weight grease is conservatively distributed around the ball bearings, ring gear, and spur gears. Only an even film of grease is desirable (approximately one thimbleful of grease should be used to lubricate a completely dry rotator). Excessive grease will only run out in high temperatures or cause power loss in low temperatures. A few drops of light weight No. 10 lubricating oil should be applied to the motor bearings.
2. Rotate upper spur gear until the inwardly protruding mechanical stop on the ring gear engages the channel shaped stop lever and pushes it far enough to the right to just open the right hand limit switch contact (it is assumed that the rotator is viewed from the side of the limit switch). This situation represents the extreme counterclockwise end of rotation. The potentiometer arm must then be rotated to its extreme counterclockwise position against the top brass stop.
3. Secure the upper bell housing upside down by the mast support in a vise with the open end of the "V" toward the bench. The boss which drives the potentiometer arm which is located in the bottom part of the ball housing will then be to the left of center.
4. Clean the inner portion of the housing and apply a small amount of grease to the ball race. Then carefully insert one ball bearing assembly with the flanged rim up and against the outer edge of the casting.
5. Grasp the operating mechanism by the flat base, steady the ring gear, invert the mechanism and lower it into the housing. In doing this, note that the serrated portion of the potentiometer arm must engage the driving boss in the housing and that the three driving lugs on the ring gear must engage the mating lugs in the top housing. This situation will result automatically if the previous instructions have been followed.

6. Determine that the top bearing surface is clean and apply a film of grease on the top ball race and the top bearing assembly. Then apply the top bearing assembly to the race with the rim downward.
7. Clean the brake housing and apply a light film of grease to the ball race only. Lower the brake housing into place so that the assembly holes will approximately line up with the threaded holes in the upper housing. DO NOT MECHANICALLY FORCE AN EXACT ALIGNMENT OF THESE HOLES WITHOUT ELECTRICALLY RELEASING THE BRAKE MECHANISM.
8. Connect the control terminals No. 1 and No. 2 only to the corresponding terminals on the rotator while it remains clamped in the vise. Momentarily operate the lever on the control box to retract the brake. This will permit the brake housing to be freely rotated for exact alignment of the holes. With the power applied to the brake, insert the 4 assembly screws and run them down to a reasonably tight position. Keep the brake retracted electrically while all 4 screws are being tightened. Release the brake electrically and use a heavy screwdriver with wrench to completely tighten the 4 assembly screws. Torque to 85 inch pounds.
9. It is suggested that all 8 wires be connected from the control box while the rotor is still on the bench and that its complete operation be checked.

TROUBLE SHOOTING SUGGESTIONS

Field experience has shown that most operational difficulties with the HAM rotor are traceable to broken, shorted, or grounded wires—usually at the terminal strips. Time spent in cutting the leads to exact lengths, tinning, forming, and wrapping around terminals, cutting insulation to exact length, and clamping to prevent strain on any single wire, will pay big dividends later in long and trouble-free performance. Put it up right—and leave it up!

Should trouble occur, first follow the suggestion on Page 5 for "Service Control Unit" and "Checking Rotor From Ground". Compare resistance values with Schematic Diagram to localize trouble. The following "symptoms" and "treatments" may also be helpful.

Mechanical Play To prevent binding under adverse operating conditions, a small amount of play is designed into the rotor. Even a degree or so of rotary play will permit several inches movement at the end of a wide antenna boom, or at the tips of the elements. Frequently the slight motion of the antenna array in gusts of wind is due more to the natural flexing of the elements and masts than it is due to actual play in the rotor mechanism.

Antenna Rotates in Heavy Wind This is usually a matter of the mast slipping in the support. For large arrays it is often necessary to drill a 3/8" hole through clamping plate, mast and mast supports and pin them together with a non-corrosive fastening. A false indication of suspected "slipping" can be obtained by comparing meter readings at different times when the beam has not been "rotated officially". Since the indication varies directly with line voltage, a change of 10% will make 36° difference in indicator at full scale of 18• difference at mid-scale. If the rotor is actually turning, the brake latch is not engaging properly. Since it is pulled into place by springs and only retracted electrically, it will be necessary to disassemble the rotor per instructions on page 6 and follow suggestions of step 12 regarding the latch mechanism.

Lack of Power so that antenna rotation is slow or sluggish. Be sure that the heavy leads in the cable were used for Terminals No. 1 and No. 2, as these leads must carry about 5 amps. to handle power for both the brake and motor. Use method on page 5 to check motor from ground. Check the capacitor. Check transformer for AC output. If the electrical circuit is OK, then check for mechanical binding. Pay particular attention to bearings and alignment of shaft on an inside tower mount. As a last resort, dismantle the rotor to check gears, bearings, etc.

No Meter Indication The brake and motor operate independent of the indicating system. If the pilot lights burn at proper brilliancy, the instrument transformer is OK and output is not shorted. Check for about 21 VDC across terminals No. 3 and No. 7 with switch operated. If this is present, check for 500 ohms across these leads to rotor (disconnected at control box). If 500 ohms is present from No. 3 and No. 7, see if the readings from No. 3 to ground and No. 7 to ground total 500 ohms. If this is so, connect an auxiliary meter from terminal No. 3 to ground and see that voltage runs from zero to about 21 volts as antenna is rotated from left to right extremes.

No Rotation—Idication OK Either the thermal cutout in the power transformer has opened to protect the motor or capacitor from excessive heat of prolonged operation or there is actually trouble on the motor circuit. After allowing time for the thermal cutout to restore service, proceed with suggestions above for "lack of power".

Grounded Leads Grounds on cable leads will burn out either the line fuses or the small fuse in the DC circuit. For full explanations, refer to Schematic. If lead No. 3 is grounded, it shorts out part of the pot, so that as rotation progresses to the other end, the full DC voltage is applied across a decreasing portion until current becomes so high that it burns out. Note also that any grounds either put an overload on the power transformer which causes the line fuse to blow, or overload the rectifier corcuit so that the 1/8 amp fuse blows.

Meter Fluctuation An intermittent condition in any component in the rectifier or meter circuits within the control box, as well as in the cable or potentiometer circuit in the rotator itself can cause meter fluctuation or error. Possible causes of such trouble may be localized by placing a test DC meter across terminals No. 3 and No. 7 and comparing the action of the test meter with the panel meter.

If the test meter fluctuates along with the panel meter, either a component in the rectifier circuit is intermittently defective, or an intermittent trouble-ground is drawing excessive current. To further localize such a condition, leave the test meter on terminals No. 3-No. 7 and remove the corresponding leads to the rotator. This removes the load from the DC circuit so the test meter will show about 12 volts. The panel meter sensitivity will be cut about in half, so it will show about 3/4 scale. Fluctuation of the test panel meters will now point to trouble in the DC rectifier circuit. Fluctuation of panel meter only, will point to intermittent trouble in the meter, multiplier resistors, or the "cal." pot.

Where the meters are steady in preceding tests, and there is fluctuation with rotator leads connected, it indicates trouble in the lead wires or rotator itself. The resultant fluctuations usually cause the meter to pulse UPWARD from a given reading. Any dirt, grease or corrosion that breaks or interferes with the ground return from the potentiometer slide will cause the needle to fluctuate from a true reading toward a center scale point. In such cases it is necessary to open the rotator per instructions on page six.

The ground connection is carried through the potentiometer pivot directly to the frame.

PARTS AND PRICE LIST

CONTROL UNIT
HAM - II/CD-44

50940-00 PART NUMBER	Control Unit, Complete (115 VAC) DESCRIPTION	Quantity	$79.95 Price Each
	ELECTRICAL		
10344-03	Fuse, 3 Amp, F-1	1	.18
10733-01*	Transformer, Power 115 VAC-Std on 50940-00	1	13.00
10735-01*	Transformer, Power 220 VAC-Std. on 50941-00	1	13.00
30112-05	Switch, Micro S-3, S-4, & S-5	3	1.60
50040-00	Capacitor (120-140 Mfd.) C-2	1	1.65
50153-00	Diode, Zener, D-1	1	4.88
50177-00*	Transformer, Meter 115 VAC-Std. on 50940-00	1	5.25
50183-00	Capacitor (30 MFD) C-1	1	1.31
50202-00*	Transformer, Meter 220 VAC-Std. on 50941-00	1	5.25
50501-00	Diode, 100 Piv. D-2	1	.55
50513-11	Resistor (10K Ohms 1/2W) R-1	1	.35
50513-12	Resistor (180 Ohms 1W) R-2	1	.35
50563-00	Fuse, 1/8 Amp., F-2	1	.29
50861-00	Line Cord, 3 Wire	1	1.50
50883-00	Meter, Lamp Holder, and Bezel ("N" Center)	1	23.10
50895-00	Bulb, Meter 1820	1	.90
50899-00	Switch, On-Off, S-1	1	1.50
50900-00	Switch, Calibration, S-2	1	4.80
	SHEET METAL AND HARDWARE		
10555-00	Strip, Solder Terminal	1	.40
10563-00	Holder, Fuse, F-1	1	1.50
30362-05	Spring, Extension (Meter Bezel)	2	.20
50185-00	Holder, Fuse, F-2	1	.42
50187-00	Knob, Switch	2	.26
50194-00	Clamp, Cable	1	.20
50300-00	Bumper, Rubber	4	.09
50399-00	Strip, Terminal (8 Pin)	1	.40
50884-00	Lever, Switch (Direction & Brake)	3	.30
50885-00	Cover, Top (Tan)	1	3.10
50886-00	Cover, Bottom (Brown)	1	3.00
50890-00	Face Plate	1	2.75
50891-00	Chassis	1	5.50

*Note: 115 VAC control unit can be converted to 220 VAC by installation of the 220 VAC power and meter transformers.

ORDER PARTS USING COMPLETE NUMBER & DESCRIPTION

To order parts, remit check or money order for total parts cost plus $.50 for postage and handling to: Cornell-Dubilier Electronics, Department "C", 118 E. Jones Street, Fuquay-Varina, N. C. 27526

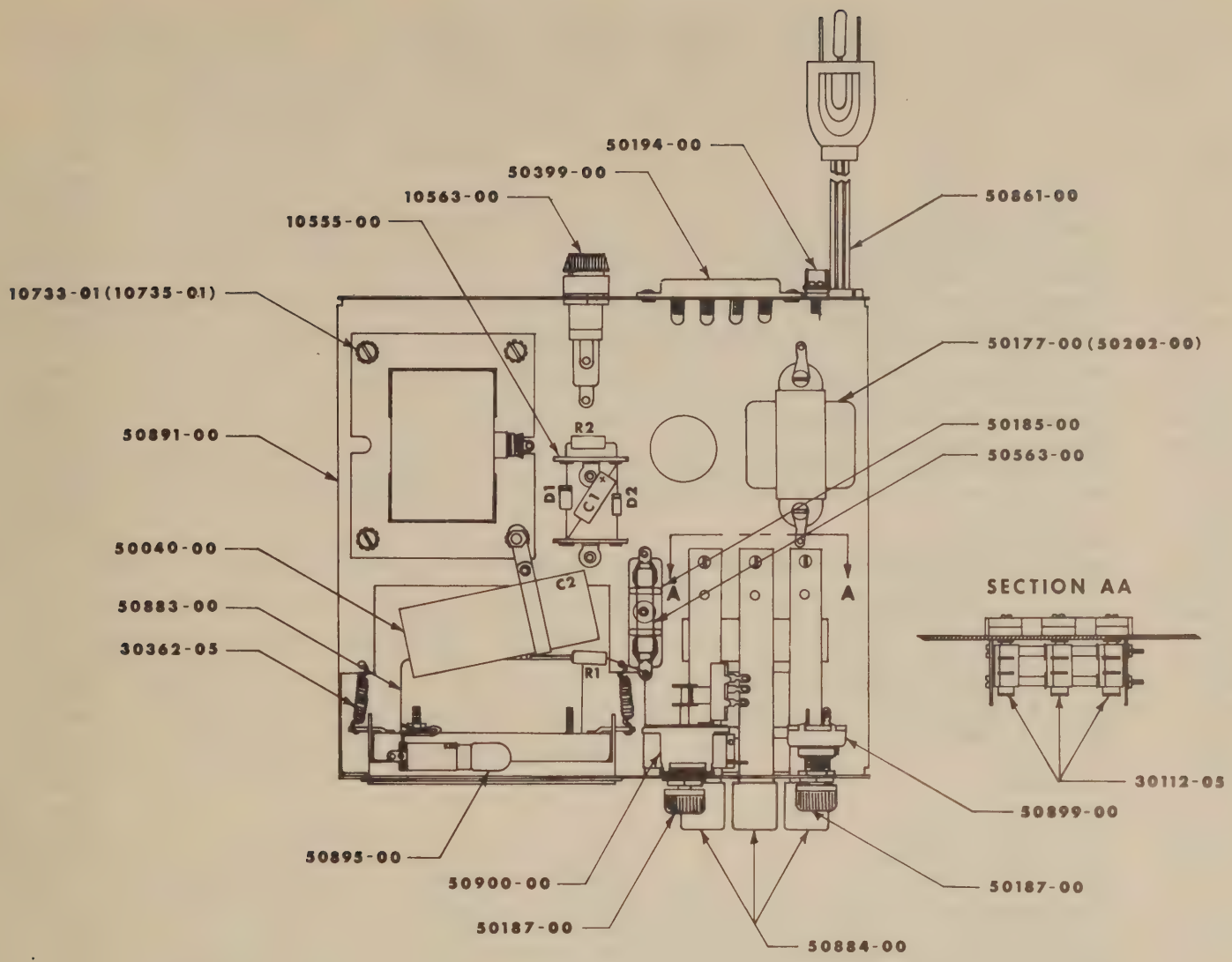


Fig. 4

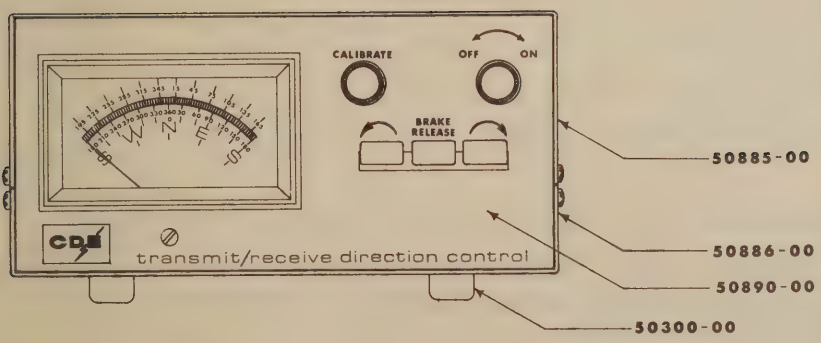


Fig. 5

WARRANTY

CORNELL-DUBILIER ELECTRONICS warrants each new CORNELL-DUBILIER ROTOR to be free from defect in material arising from normal usage. Its obligation under this warranty is limited to replacing, or at its option repairing the rotor which, after regular installation and under normal usage and service, shall be returned within **ONE (1) YEAR** from date of original consumer purchase of the rotor to **Cornell-Dubilier Electronics, Rotor Service Dept., 118 E. Jones St., Fuquay-Varina, N. C. 27526**, together with satisfactory evidence of such purchase, and which shall be found to have been thus defective in accordance with the policies established by CORNELL-DUBILIER ELECTRONICS.

The obligation of CORNELL-DUBILIER ELECTRONICS does not include either the making or the furnishing of any labor in connection with the installation of such repaired or replacement rotor, nor does it include responsibility for any transportation expense.

CONDITIONS AND EXCLUSIONS

This warranty is expressly in lieu of all other agreements and warranties, expressed or implied, and CORNELL-DUBILIER ELECTRONICS does not authorize any person to assume for it the obligation contained in this warranty and neither assumes nor authorizes any representative or other person to assume for it any other liability in connection with such CORNELL-DUBILIER Rotor.

The warranty herein extends only to the original consumer and is not assignable or transferable, and shall not apply to any rotor which has been subject to alternation, misuse, negligence or accident.

CORNELL-DUBILIER ELECTRONICS
118 E. Jones Street
Fuquay-Varina, N. C. 27526

PARTS AND PRICE LIST

HAM-II ROTATOR

PART NO.	DESCRIPTION	QUANTITY	PRICE EACH
50232-00	Rotator Unit Complete	1	$82.95
50349-01	Lower Mast Support Assy.	1	3.51
50339-00	Terminal Cover Plate for Lower Mast	1	.09
50155-00	Grommet for Terminal Cover	1	.09
50304--01	Upper Mast Support (Bell Casting)	1	7.01
50095-00	Brake Housing (Lower Casting)	1	7.04
50335-01	Ball Bearings	98	.09
50113-00	Ball Retainers	2	.88
50097-00	Brake Support Casting	1	5.25
50370-00	Base Casting & Gear Shaft Assy.	1	4.25
50310-00	Motor Pinion (Nylon)	1	.26
50112-00	Gear and Pinion (1st, 2nd, and 3rd from Motor)	3	4.41
50111-00	Gear and Pinion (Thick pinion 4th from Motor)	1	5.25
50107-00	Final Spur Gear	2	2.21
50313-00	Ring Gear (Cast Aluminum)	1	1.40
50341-00	Small Gear Spacer (Brass)	1	.09
50378-00	Large Gear Spacer (Steel)	1	.35
50379-00	Bushing for Final Spur Gear	1	.35
50460-00	Motor & Pinion Assy.	1	13.16
50122-00	Motor Mounting Plate with Studs	1	1.75
50231-00	Potentiometer Assembly (Complete)	1	7.88
50090-00	End of Rotation Switch Assembly (Complete)	1	2.16
50338-00	Stop Lever Assembly	1	.26
50099-00	Solenoid Only	1	8.77
50100-00	Solenoid Pin	1	.26
50101-00	Solenoid Pin Spacers	3	.26
50282-06	Solenoid Pin RetainingRing	2	.09
50114-00	Solenoid Retracting Springs	2	.18
50096-00	Retracting Spring Clip	2	.09
50103-00	Brake Wedge	1	3.00
50098-00	Connecting Links	2	.35
50102-00	Connecting Link Pin	1	.26
50117-00	Brake Wedge Support	1	.70
50104-00	Brake Latch	1	.88
50106-00	Latch Pins	2	.18
50282-04	Latch Pin Retainers	2	.09
50105-00	Latch Springs	2	.18
50399-00	Terminal Board Assembly (8 Terminals)	1	.40
WL-28-7	Retainer for Stop Lever Assembly	3	.09
WP-54	Washers	3	.09
SS-64-2	Self-Tap Screw 6-32x⅜	2	.09
SL-5-2	Hex Hd. Screw (Taptite) 12-24x¾	4	.09
50463-00	Mounting Kit	1	5.25
	(2) B14 50115-00 Mast Clamp		
	(4) A08 50382-00 "U" Type Bolt (Stn. Stl.)		
	(4) A14 50502-00 Spacer		
	(6) SM-217-2 Screw, Hex Hd. ¼-20x1¼		
	(10) NM-68 Hex Nut ¼-20 (Stn. Stl.)		
	(14) WK-11-2 Lockwasher, Split ¼"		

ORDER PARTS USING COMPLETE NUMBER & DESCRIPTION

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Appendix IX
Rotor Control Interface

ShackMaster may control an antenna rotor through the RCB-1 Rotor Control Board interfaced to a Hygain/Telex CD-45-II Rotor System control unit. (Other similar control units, such as the HAM IV or T^2X units may also be compatible with the RCB-1.) The system assumes the rotor is set up for north center. The rotor control board mounts inside the control unit, and simulates operation of the clockwise, counter clockwise, and brake switches in response to Touch-Tone commands sent to ShackMaster. The control unit remains available for normal use locally when ShackMaster is not being used.

Commands available through ShackMaster include rotate clockwise (right), rotate counter clockwise (left), stop, interrogate direction, rotate to a particular direction in degrees, and "budge" clockwise or counter clockwise. ShackMaster always knows the direction of the rotor by measuring the potentiometer voltage from the control unit. An adjustable delay keeps the brake released for several seconds to allow the rotor to coast to a stop.

Installing the Rotor Control Board

The RCB-1 board is designed to mount inside the bottom of the control unit. Unplug the control unit from the ac line. Remove the mounting hardware for the smaller of the two transformers, and mount the rotor control board using the spacers and screws supplied with it. Position the board so that "SIG", "GND", "+12", "CCW", and "CW" are oriented toward the back of the control unit. Wire the points from the RCB-1 to points inside the rotor control unit as follows:

"2"	CW and CCW switches common terminal, to rear panel terminal 2
"5"	CW switch terminal, to rear panel terminal 5
"6"	CCW switch terminal, to rear panel terminal 6
"3 or 7"	"T5" on p.c. board, to rear panel terminal 3
"GND"	Ground lug on top at small transformer
"BRAKE RELEASE"	Brake release switch terminals (two wires)

Several signals must be connected from the rotor control board to ShackMaster. In addition, a +12 volt supply signal, which is not available from the ShackMaster logic connector, must be obtained. Bring these wires out the back of the control unit, being careful not to pinch them when closing up the unit and tightening its screws. Wire the signals as follows:

"CW"	Logic connector pin 17
"CCW"	Logic connector pin 1
"GND"	Logic connector pin 13 or 25
"SIG"	Logic connector pin 19
"+12"	To 12 volt power supply, minimum 100 mA capacity; do not obtain from ShackMaster logic connector

The RCB-1 Rotor Control Board will now allow you to control your antenna rotor through ShackMaster.

Adjustments

Two pots on the RCB-1 board allow calibration of the rotor direction voltage, and adjustment of the brake hang-in time.

First calibrate the rotor control unit as described in the manual, independent of the RCB-1. Now turn the rotor using the control unit switches to exactly 90 degrees as indicated on the meter. Read back the direction through ShackMaster (Touch-Tone "4" if bypassed, or "[prefix]4" if not bypassed.) Adjust pot R2 on the rotor control board for a synthesized speech readback of 90 degrees.

Turn the rotor using ShackMaster commands "41" (left) or "43" (right). Stop with "42". Notice that when stopping, the brake relay hangs in for a period of time (you should be able to hear the second relay drop out). Adjust pot R1 for the desired hang time (typically two or three seconds), which should depend on the size of the antenna array controlled by the rotor.

Commands

ShackMaster controls the rotor through several Touch-Tone commands. They include:

Left (ccw)	**[your prefix] 4 1 [#]**
Right (cw)	**[your prefix] 4 3 [#]**
Stop	**[your prefix] 4 2 [#]**
Budge Left (ccw)	**[your prefix] 4 4 [#]**
Budge Right (cw)	**[your prefix] 4 6 [#]**
Go to direction	**[your prefix] 4 (degrees - 0-360) [#]**
Interrogate	**[your prefix] 4 [#]**

The Left and Right commands cause the rotor to turn continuously until stopped. ShackMaster stops the rotor automatically at approximately 195 degrees when

turning left, and 165 degrees when turning right, to prevent excessive twisting when the rotor hits the stopper. The Stop command may be entered at any time.

The Budge Left and Budge Right commands apply power to the rotor for a half second to cause the rotor to turn slightly in either direction. After coasting, ShackMaster reads back the new rotor direction.

The Go command causes the rotor to turn to a particular direction specified in the command. Directions from 165 to 195 are ignored by this command, since they are dangerously near the ends. When the desired direction is reached, the actual direction measured is spoken by ShackMaster. There may be a small error because the rotor will coast for a short time after power is removed. ShackMaster intentionally "undershoots" by about eight degrees to allow for coasting. While rotating in response to the Go command, other Touch-Tone commands may not be sent to ShackMaster.

The Interrogate command causes ShackMaster to read back the current rotor direction. In addition, it reads back "Right" or "Left" if the rotor is currently turning.

Fig. 6

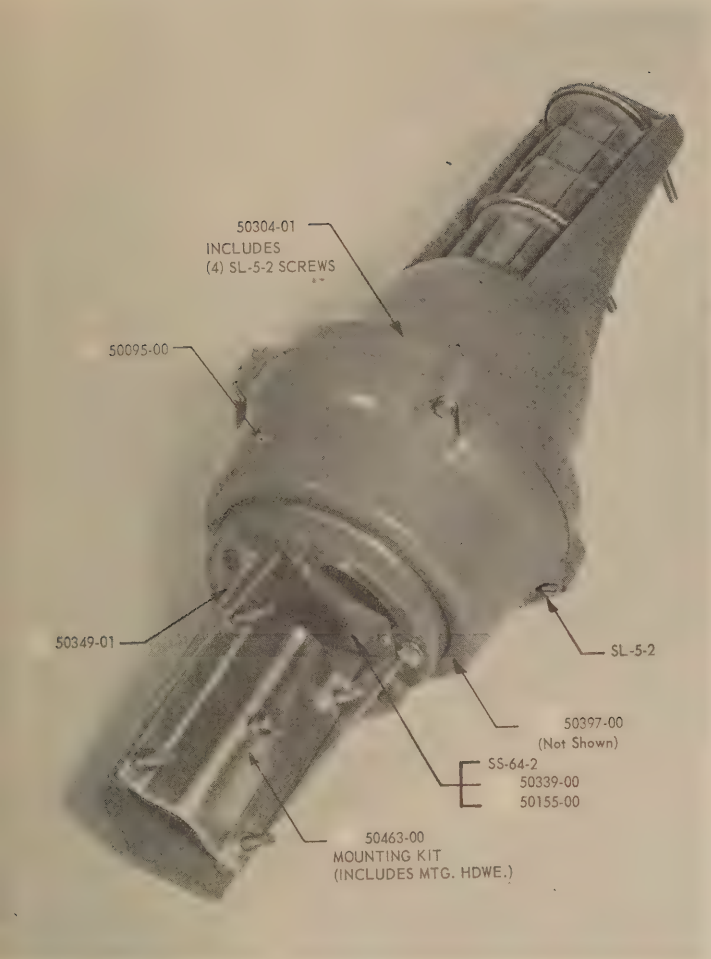
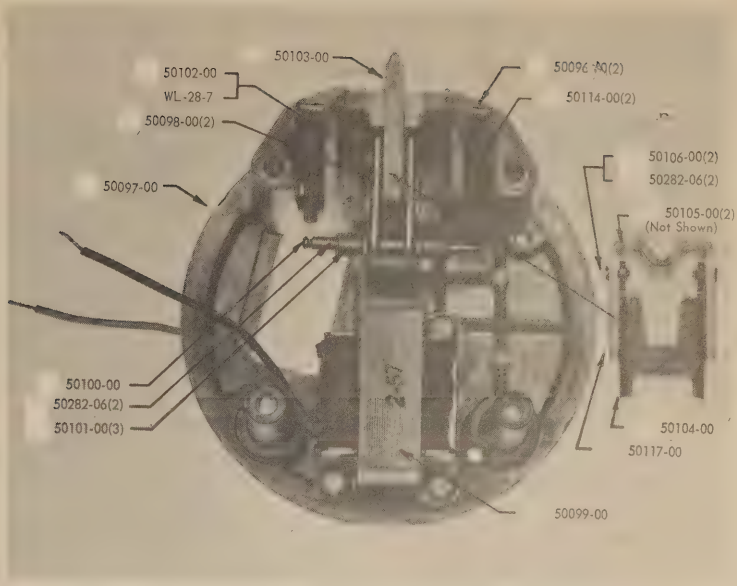


Fig. 8



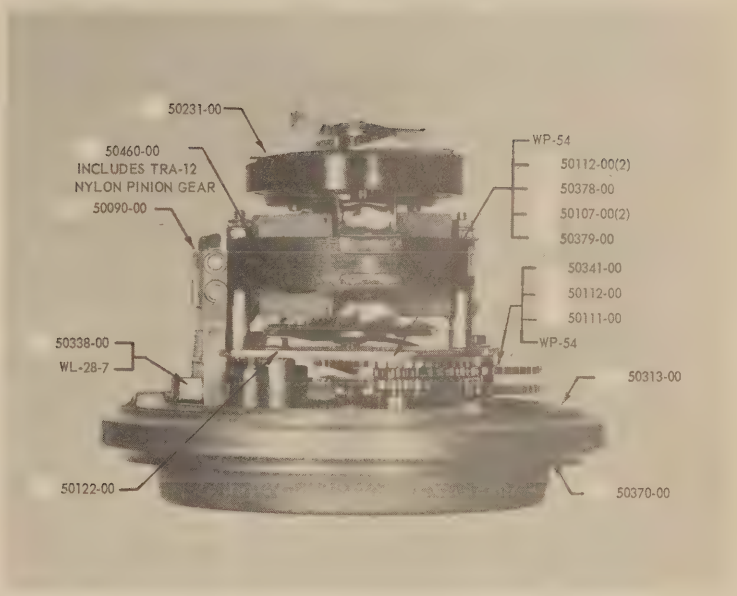


Fig. 7

ACCESSORY KITS

ALTERNATE METER SCALE

50924 - 10 South Center Meter Scale Kit 3.00

SOUTH CENTER SCALE KIT

The stock Ham II/CD-44 control unit is produced with a North Centered meterscale. Since some locations and/or popular working areas may favor rotation stops at North, we provide a South Centered meter scale kit for field modification.

INSIDE TOWER MOUNTS

50559 - 10 Tower Spacing Plate Kit 4.50

A cyclindrical space of 21.6 cm (8.5 inches) diameter and 38.1 cm (15 inches) height will accommodate the Ham-II rotator bolted to a flat plate without the lower mast support attached. To facilitate such mounting, a steel plate, cut out to fit against the bottom of the brake housing and clear the terminals, is available. This plate, part number 50559-10, has four heavy bushings drilled to match the screw holes and to hold the rotor 12.7 mm (.5 inches) above the tower plate in order to provide clearance for the control cable.

On any inside tower installation, care must be exercised to get the top mast shimmed to the exact rotational center of the rotator upper mast support. The geometry is such that a mast of 52 mm (2.062 inches) will be exactly centered. For each 1.6 mm (.0625 inches) less mast diameter used, .8 mm (.031 inches) of shim must be wrapped around the mast at the clamping points.

HAM II SPECIFICATIONS

- Input Voltage: 115 VAC 50-60 HZ
  Optional: 220 VAC 50-60 HZ
- Motor: 24 VAC, 2.25 Amp, Split Phase
- Power transformer: 115/26 VAC, 10% duty, thermal protected.
  Optional: 220/26 VAC
- Meter transformer: 115/23 VAC, continuous duty.
  Optional: 220/23 VAC.
- Meter: D.C. voltmeter 1000 ohms/volt
- Meter scale: Direct reading, North centered. 5° increments.
  Optional: South Centered.
- Recommended cable: Belden 8448 or equivalent for up to 45 meters (150 feet).
  Two wires No. 18, 6 wires No. 22.
- Maximum Cable Resistance: Not over 1 ohm for conductors 1 and 2. Not over 2.5 ohms for conductors 3 through 8.
- Rotation time: 45-60 seconds with 60 HZ input.
- Brake: Positive, electrically operated wedge. 96 segments spaced 3° 45' apart.
- Rotator size: 20 cm (8") maximum diameter by 50 cm (20") high with lower mast support. Without lower mast support, 34 cm (13.5") high.
- Permissable mast size: From 35 mm (1.37") to 52 mm (2.062").
- Control box size: 20.5 cm (8.125) wide x 21 cm (8.25") deep x 10.5 cm (4.125") high.
- Mounting hardware: Stainless steel.
- Shipping cubature: 37,350 cucms (2280 cu. in.).
- Shipping weight: 13.15 kg (29 pounds).

CDE HAM II ROTOR

2. Turn the rotor to the compass location by pushing down and releasing either the left hand lever or the right hand lever. **ALLOW A FEW SECONDS FOR THE ROTOR TO COAST DOWN.** Then re-engage the brake wedge by releasing the "Brake Release" (middle) lever.

C. OPERATING PRACTICE

The rotator has several mechanisms to protect it from misuse but the following **PRECAUTIONS ARE ADVISABLE:**

1. If you have a very large beam, the rotor can be "nudged" to exaclty the desired position by alternately working the left and right control, allowing it to **COAST DOWN** before the brake wedge is allowed to engage.
2. It is advisable not to run it full speed into the end of rotation.
3. Upon completion of turning, always allow the rotor to **coast** down by keeping your finger on the "Brake Release" after you have released the rotation lever. This procedure will allow the rotator to stop **before** you re-engage the brake wedge. Observing this sequence prevents the rotator from stopping suddenly thus preventing undue stress on the rotator, beam, and tower.

The motor has an internal brake which controls the coast down time and deceleration. The internal motor brake is usually strong enough to prevent pinwheeling during operation even in high winds. If the rotator is being operated in a very high wind, observe the operation of the needle. A little practice will acquaint the owner how to operate the rotor smoothly.

VII. GROUNDING

The tower, or other metal support device, must be grounded to **earth** ground **at location.** Use heavy copper cable looped so that if the tower comes down for any reason there will be adequate slack to prevent the ground wire from breaking. Use one or more 18" copper jacked steel stakes driven into the moist earth and fasten the wire securely at the stake and at the tower.
As mentioned in the "Cautions" portion, the steel chassis of the control box should be either grounded to a metal cold water pipe in the house or back to the electric service entrance box where the power comes into the house. This normally is accomplished with the wire of the 3 prong plug which then depends on the 120 volt wall outlet being adequately grounded back to the service entrance as well as to the utility ground. **If there** is any doubt, have this checked by a licensed electrician.

VIII. SOUTH CENTERED METER SCALE CONVERSION

The stock HAM IV control unit is shipped with the meter scale installed for North center operation, ends of rotation at the South position. Since some geographic locations and/or popular working areas may favor having the Meter South Center, ends of rotation at the North position, we have provided the HAM IV with a reversible meter scale.

WE RECOMMEND THE FOLLOWING PROCEDURE:

1. Disconnect the 120 VAC power cord.
2. Remove the eight-wire control cable, carefully labeling each wire with its corresponding terminal number. This operation may be omitted if the control box can be worked on easily without removing the leads.
3. Remove the top and bottom covers.
4. Slip the lamp and holder off the lamp holder bracket. Loosen the hex nut on the transformer that is holding the lamp holder bracket and swing the bracket clear of the wires leading to the printed circuit board.
5. Carefully remove the hex nuts on the meter studs to free the printed circuit board. Slip the P.C. board off the studs and pull it down under the chassis. **Caution:** It is good practice to use a short test lead or jumper wire to short the meter movement when it is not in the circuit.
6. Loosen the meter retaining clips and remove the meter from the chassis.
7. Insert a small pen knife between the clear meter cover and black housing at the either corner of the top edge and gently pry the cover loose from that corner. Repeat for the other corner. Meter cover should pop off.
8. Carefully slip a pen knife under each corner of the lower edge of the white meter scale and twist slightly until the scale clears the two small indexing pins. Remove the scale, turn it over, and re-install it. Make sure the scale fits over the indexing pins and that it is flush and tight against the black housing. This will assure free movement of the indicator needle.
9. Re-install the meter (remove the temporary jumper), the P.C. board, and lamp hardware. Check for pinched, shorted and/or overstressed wires.
10. Re-install the top and bottom covers.
11. Re-connect the eight wire control cable in the exact sequence as they were removed.

If your beam was installed originally using the HAM IV with a North Center Scale, the antenna mast must be loosened and repositioned. In order for the meter to indicate properly, the front of your beam must point North when the rotor is at the ends of rotation.
Re-calibrate the meter.

IX. 50559 - 10 Tower Mounting Plate Kit $12.00

The tower mounting plate kit is a flat plate equipped with four 0.5 inch standard bushings drilled to match the hold down screw holes in the bottome of a CDE Bell type rotator. The plate essentially is designed to allow enough clearance under the bottom of the rotator to permit the rotator to turn without touching the 8-wire control cable.
On any inside tower installation, care must be exercised to get the top mast shimmed to the exact rotational center of the rotator upper mast support. The geometry is such that a mast of 52 mm (2.062 inches) will be exactly centered. For each 1.6 mm (.0625 inches) less mast diameter used, .8 mm (.031 inches) of shim must be wrapped around the mast at the clamping points.

X. 51467 - 10 Heavy Duty Lower Mast Support Kit $32.00

The stock HAM IV is intended to mount on the base plate inside of the tower. However, in some instances outside tower or mast mounting is desired as per figures 2 and 3. This kit, part number 51467-10, contains a heavy duty lower mast support and the necessary hardware to facilitate mounting the HAM IV on top of a tower stub or mast. Caution, when the rotor is installed using the lower mast support kit, the antenna size must be restricted to 7.5 square feet of wind surface area.

CONSTRUCTION and SERVICING

I CONTROL UNIT - GENERAL DESCRIPTION

See Page 12 and 13

1. **POWER:** The on/off switch is a turn-to-operate type. The unit is protected by a 3 amp line fuse which is located in a fuse holder on the back panel. The power transformer supplies power for the rotator motor. The transformer is protected by a thermal cut out switch located in the primary. If the cut-out switch opens, turn the unit off and wait 10-15 minutes before resuming operation.
2. **METER CIRCUIT:** The position indicator meter and its circuitry is powered by the meter transformer. When the power switch is "on" the meter is illuminated and continually indicates rotator position. Stability is assured by the 13 volt zener regulated power supply. The meter circuit is protected by the ⅛ amp fuse.
3. **CALIBRATION:** The calibration switch is a push-on/push-off, turn to adjust type. It calibrates the right hand position (full scale) of the meter.
4. **ROTATOR CONTROL:** CCW rotation is controlled by the left hand lever and CW rotation by the right hand lever. The center lever is the brake release.

II ROTATOR - GENERAL DESCRIPTION

See Pages 14 and 15

1. **OUTER HOUSING:** The upper mast support (Bell) and the brake housing are cast aluminum. The upper mast support is secured to the brake housing by four 12-24 x ¾" self tapping hex head screws.
2. **POSITION SENSOR:** The position sensing potentiometer is located in the top of the bell casting.
3. **DRIVE:** A low voltage AC motor and its associated gears drive the output ring gear at about RPM. The ring gear in turn is mechanically interlocked in the upper mast support (Bell).
4. **BRAKE:** The brake wedge and its associated components are enclosed by the lower housing casting. Seventy-five grooves are cast into the inside surface of the brake casting walls which are engaged by the brake wedge. The wedge is retracted by a solenoid which is controlled by the "Brake Release" (Center) switch on the Control Unit.
5. **ROTATION LIMITS:** Activated by the stop arm are two electrical end of rotation switches which disconnect the motor power just before the rotating bell housing reaches its full CW (0°) or CCW (360°) positions.
6. **BEARINGS.** Two rows of ball bearings are provided. Lubricate sparingly with factory approved special low temperature grease (P/N 51497-10).

III. TROUBLE SHOOTING

A. GENERAL

Most operational difficulties with rotors are traceable to broken, shorted, or grounded wires usually at the terminal strips. Time spent in cutting the leads to exact lengths, tinning, forming, and wrapping around terminals, cutting insulation to exact length, and clamping to prevent strain on any single wire, will pay dividends.

B. MECHANICAL PLAY

Frequently the slight motion of the antenna array in gusts of wind is due more to the natural flexing of the elements and mast than it is due to actual play in the rotator mechanism. A slight amount of "play" is built into the rotator to avoid binding due to environmental changes.

C. ANTENNA ROTATES IN HEAVY WIND

This is usually a matter of the mast slipping in the support. If "slipping" or "turning" is suspected, return the rotator to the end of rotation and visually check to be sure that the antenna is in the original stop location as installed. Check the nuts on the U bolts to insure that they are tight. Also check that the center bolt in the mast clamp is tight.

D. LACK OF POWER

If the antenna rotation is slow or sluggish or hard to start, check for proper voltages. If the voltages are correct, the 140 MFD motor start capacitor could be at fault. It is recommended that a new capacitor be tried before any other action is taken. If the electrical circuit is OK, then check for mechanical binding. Pay particular attention to bearings and alignment of the shaft on on inside tower mount. On any inside tower installation, care must be exercised to get the top mast shimmed to the exact rotational center of the rotator upper mast support.

E. IMPROPER METER INDICATION

The brake and motor operate independently of the indicating system. If the pilot light burns at proper brilliancy the instrument transformer is OK and the output is not shorted. Check the ⅛ AMP meter circuit fuse with an ohmmeter. Check for about 13 VDC across terminals No. 3 and No. 7 with the switch operated. If the proper voltage is not obtained, check the individual components in the meter circuit. If the 13 VDC is present, check for 500 ohms across rotor leads No. 3 and No. 7. If 500 ohms is present from No. 3 and No. 7, see if the readings from No. 3 to ground and No. 7 to ground total 500 ohms.

NOTE: If the needle remains in the right hand "S" position check to be sure the calibration switch is not in the "calibrate" position.

An intermittent condition in any component in the rectifier or meter circuits within the control box, as well as in the cable or potentiometer circuit in the rotator itself can cause meter fluctuation or error. Possible cause of such trouble may be localized by placing a test DC meter across terminals No. 1 and No. 3 or No. 1 and No. 7 comparing the action of the test meter with the panel meter.

F. NO ROTATION - INDICATION OK

Either the thermal cutout in the power transformer has opened or there is actually trouble in the motor circuit. After allowing time for the thermal cutout to restore service, proceed to "checking rotator from ground" and "checking control unit".

G. GROUND WIRES

Grounds on cable leads can burn out either the line fuse of the small fuse in the meter circuit. If lead No. 3 or lead No. 7 is grounded, it shorts out part of the potentiometer so that as rotation progresses to the other end, the full DC voltage is applied across a decreasing portion until current becomes so high that the potentiometer burns out. Note also that any grounds may put an overload on the power transformer which could cause the line fuse to blow, or overload the rectifier circuit so that the ⅛ amp fuse blows.

H. CHECKING THE CONTROL UNIT

1. VOLTAGES WITH UNIT PLUGGED IN.

   To check the control unit, plug the line cord nto 120 volt AC power. With no connections to the terminals turn the on-off switch to the "on" position, the meter light will illuminate. The meter needle will remain on the left hand "S" Terminals 1 and 2 should show 30 volts AC (approximately) when the brake lever is depressed.

   Terminals 1 and 5 should show 30 volts AC with brake release lever depressed and CW lever depressed.

   Terminals 1 and 6 should show 30 volts AC with brake release lever depressed and CCW lever depressed.

Terminals 3-7 should show approximately 13 VDC.

2. RESISTANCES WITH UNIT NOT PLUGGED IN

Disconnect the AC power source and remove the eight wire control cable. Be sure to tag each wire with the corresponding terminal number.

The control box can be checked without removing the cover by using a volt-ohmmeter to check values across terminals. Resistance across terminals No. 1-2 should read .4 Ohms. Read same value across terminals No. 1-5 with clockwise switch lever (right-hand) depressed and across terminals No. 1-6 with counterclockwise switch lever (left-hand) depressed. Resistance across input line cord with on-off switch in the "on" position and the brake lever depressed should read 3.8 Ohms.

I. CHECKING THE ROTATOR FROM THE GROUND

You may possibly avoid bringing the rotator down by making electrical checks from the control box position. This is done by disconnecting the 8 wires from the screw terminals and tagging them carefully No. 1 through No. 8 to correspond with the terminal numbers from which they were removed. From the schematic diagram it is apparent that the resistance of the lead wires will be added to the resistance of the motor windings and potentiometer strip in making the resistance checks as shown in Table 1.

To Check	Read Resistance	Between Terminals
Brake Solenoid	.75 ohms + leads	1-2
½ Motor Winding	2.5 ohms + leads	1-8
½ Motor Winding	2.5 ohms + leads	1-4
½ Motor + Switch	2.5 ohms + leads	1-5
½ Motor + Switch	2.5 ohms + leads	1-6
Entire Motor	5 ohms + leads	8-4
Right Limit Switch	0 ohms + leads	8-5
Left Limit Switch	0 ohms + leads	4-6
Entire Pot Switch	500 ohms	3-7
Pot Arm to + End	0 to 500 ohms	3-1
Pot Arm to — End	0 to 500 ohms	1-7

Table 1

IV. DISASSEMBLY OF THE ROTATOR

In order to service the rotator, the unit must be disassembled. We recommend the following procedure:

1. Set the rotator on a flat surface.
2. Remove four screws and carefully raise top casting to expose potentiometer and drive mechanism.
3. Carefully remove upper ball retaining ring. Keep it circular, and lay it on clean paper.
4. See that the potentiometer strip is clean and not burned at either end and that arm is clean at the point of contact. Use only fine rouge cloth to polish the contact arm.
5. If the drive ring happens to be near the end of rotation, hold the unit horizontal, operate the spur gear to rotate the mechanical stop on the drive ring away from the area of the limit switch. See that the mechanical stop lever (which is positioned between the two limit switches) will open each electrical contact before it hits the corresponding mechanical stop. Also see that the stop lever has not been deformed and that the electrical contacts are clean and uncorroded.

   Rotate the top spur gear several revolutions to determine that the motor and its bearings are operating freely. Look for broken teeth in any of the gears.
6. Lift the motor and brake mechanism out of the brake housing. Carefully remove the ball bearing retainer and place it on a clean piece of paper.
7. Remove the ring gear from the motor base. This is accomplished by first pulling up on the side opposite the gear train. Then raise the entire ring slightly upward with the side away from the gear train so that it will slide out from under the gears. Examine closely for evidence of broken or worn teeth.
8. Examine the inside of the screw terminal strip to see that there is proper clearance between the solder lugs and frame and that there are no breaks in the insulation. Pay particular attention to the insulation at the point where the wires are held in the metal clip.
9. Examine the teeth in the brake casting.
10. To separate the motor, pot, and gear assembly from the brake assembly, unsolder the solenoid leads from the terminals 1 and 2. Remove the screws holding the terminal board to the casting. Then remove the four large screws in the base. Be careful to clear the wires and the terminal strip through the opening.
11. To remove the potentiometer, remove the hex nuts and unsolder the leads. The mounting studs are integral to the motor and bell. In replacing the pot, be sure the connections are on the side which overhangs the motor.
12. To replace the motor, first remove the pot per Paragraph 11, then unsolder the black motor lead from the screw terminal 1, the red lead from the inside left limit switch lug, and the blue lead from inside the right switch lug. The fastenings holding the motor on the studs may then be removed and the motor pulled up and out. In replacing a motor, be sure to see that that the round hole in the motor is next to the limit switch. Use a double lock nut on this stud near the limit switch, to provide clearance for the leads. Use special internal-external lockwasher over the stud that works in the slotted hole in the motor. Be sure that the pinion is snug against the spur gear before tightening this fastener over the slot.
13. When it is necessary to closely inspect or replace gears, it is possible to remove the motor, limit switch, pot, and terminal strip without unsoldering more than the solenoid leads from terminals 1 and 2. Remove the motor fastenings from the mounting studs. Work the motor up and out, exercising care in pulling the leads and terminal strip through the window in the gear housing. Remove the plate to expose the gears. Carefully note the positions for proper replacement.

V. RE-ASSEMBLY OF THE ROTATOR

It is assumed in the following instructions that the brake mechanisim is assembled and operative. The motor and gear train along with the potentiometer and the limit switches are likewise assembled and wired and operative.

It is not likely that the brake wedge will be exactly positioned in relation to the teeth in the brake housing to permit proper assembly unless the brake mechanism is retracted. For this reason it is necessary to operate the brake mechanism electrically during step 8 of the assembly of the rotator unit.

1. See that a small amount of low temperature, high quality, light weight grease is conservatively distributed around the ball bearings, ring gear, and spur gears. Only an even film of grease is desirable (approximately one thimbleful of grease should be used to lubricate a completely dry rotator). Excessive grease will only run out in high temperatures or cause power loss in low temperatures.

2. Rotate the upper spur gear until the inwardly protruding mechanical stop on the ring gear touches the channel shaped stop lever and pushes it far enough to the left to just open the left hand limit switch contact (it is assumed that the rotator is viewed from the side of the limit switch). This situation represents the extreme clockwise end of rotation. The potentiometer arm must then be rotated to its extreme clockwise position against the top stop.

3. Secure the upper bell housing upside down by the mast support in a vise with the open end of the "V" toward the bench. The boss, which drives the potentiometer arm that is located in the bottom part of the housing, will then be to the left of center.

4. Clean the inner portion of the housing and applya small amount of grease to the ball race. Then carefully insert one ball bearing assembly with the fringed rim up and against the outer edged of the casting.

5. Grasp the operating mechanism by the flat base, steady the ring gear, invert the mechanism and lower it into the housing. In doing this, note that the serrated portion of the potentiometer arm must engage the driving boss in the housing and that the three driving bosses on the ring gear must engage into the mating recesses in the top housing. This situation will result automatically if the previous instructions have been followed.

6. Clean the exposed bearing race and apply a film of grease. Then apply the top bearing assembly to the race with the rim downward.

7. Clean the brake housing. Lower the brake housing into place so that the assembly holes will approximately line up with the threaded holes in the bell housing. **DO NOT MECHANICALLY FORCE AN EXACT ALIGNMENT OF THESE HOLES WITHOUT ELECTRICALLY RETRACTING THE BRAKE MECHANISM.**

8. Connect the control unit terminals No. 1 and No. 2 only to the corresponding terminals on the rotator while it remains clamped in the vise. Momentarily operate the "Brake Release". This will permit the brake housing to freely rotate for exact alignment of the holes. With the brake retracted, secure the upper most support (bell) to the lower brake housing. Tighten finger tight. With the brake retracted, tighten all 4 bolts in an alternate pattern to approximately 85 inch pounds of torque. Recheck the brake to make sure that it opeates freely.
   It is suggested that all 8 wires be connected from the control box while the rotor is still on the bench and that its complete operation be checked.

VI. HOW TO GET FACTORY SERVICE

If service is required, the unit must be packed securely and sent prepaid to:

CORNELL-DUBLIER ELECTRONICS
Rotor Service Department
118 East Jones Street
Fuquay-Varina, N.C. 27526
919-552-2281

For units that are in warranty, no charge will be made for any repair work required. Include a copy of your sales receipt. For out-of-warranty units, the following flat rate charges apply:

Control Unit Only	$30.00
Rotator Only	$45.00
Complete Unit - Rotator and Control	$65.00

The above flat rate charge includes rebuilding the unit, replacing all defective and/or worn parts, and return freight charges. CDE reserves the right to change prices at its option. When returning items for repair, a check or money order for the repair charges must be included. Be sure to include your name, address, zip code and telephone number. Also give a brief description of the problem.

LIMITED WARRANTY

CORNELL-DUBLIER ELECTRIC CORPORATION (CDE) warrants that your new ROTOR has been manufactured free of defects in design, material and workmanship. If this product fails to give satisfactory service due to defects covered by warranty, including any warranty implied by law such as WARRANTIES OF MERCHANTIABILITY OR FITNESS, for a period of ONE YEAR FROM THE DATE OF PURCHASE, CDE will, at its option, replace or repair the unit, or any defective part free of charge

To obtain warranty service, return the ROTOR to your dealer, or pack it securely, and send it with proof of purchase date and a letter explaining the problem, shipping cost prepaid, to: CORNELL-DUBLIER ELECTRIC CORPORATION WARRANTY REPAIR DEPARTMENT, 118 E. JONES ST., FUQUAY-VARINA, N.C. 27526.

IMPORTANT

Warranty service covers repair or replacement of the ROTOR only. CDE is not responsible for costs of removal or reinstallation, or shipping to the place of repair. The warranty period is not extended due to repair or replacement.

CDE reserves the right to make reasonable charges for service if there is evidence of damage due to alteration, misuse or installation not according to the enclosed instructions.

CDE IS NOT RESPONSIBLE FOR DAMAGE TO OTHER EQUIPMENT OR PROPERTY OR FOR ANY OTHER CONSEQUENTIAL OR INCIDENTAL DAMAGES OF ANY KIND, WHETHER BASED ON CONTRACT, NEGLIGENCE OR STRICT LIABILITY. MAXIMUM LIABILITY SHALL NOT, IN ANY CASE, EXCEED THE PURCHASE PRICE OF THE UNIT.

(Some states do not allow limitations on how long an implied warranty lasts, or the exclusion or limitation of incidental or consequential damages, so the above limitations and exclusion may not apply to you.)

(This warranty gives you specific legal rights. You may also have other rights which may vary from state to state)

IF YOUR UNIT IS DAMAGED, CONTACT YOUR DEALER OR THE SHIPPER. IF ANY OF THE ITEMS ARE MISSING, RETURN THE COMPLETE UNIT TO YOUR DEALER OR WRITE THE FACTORY FOR ASSISTANCE. A COPY OF YOUR SALES RECEIPT MUST ACCOMPANY ANY RETURN.

HAM IV SPECIFICATIONS

- Input Voltage: 120 VAC 50 - 60 Hz
  Optional: 220 VAC 50 - Hz
- Motor: 24 VAC, 2.25 Amp, Capacitor Start, Capacitor Run
- Power Transformer: 120 VAC/26 VAC 10% duty, thermal switch protected
  Optional: 220 VAC/26 VAC 10% duty thermal switch protected
- Meter Transformer: 120 VAC/23 VAC Continuous duty
  Optional 220 VAC/23 VAC Continuous duty
- Meter DC voltmeter 1000 ohms/volts, 1 MA full scale
- Meter Scale: Direct reading: North centered, 5° increments
  Optional South centered, 5° increments
- Recommended 8-wire interconnect cable: Stranded Copper

Maximum Length	Gauge for Terminals 1 & 2	Gauge for Terminals 3-8
125' (38M)	#18 (1.19mm)	#22 (.76mm)
200' (61M)	#16 (1.42mm)	#20 (.97mm)
300' (91M)	#14 (1.75mm)	#18 (1.19mm)
500' (152M)	#12 (2.12mm)	#16 (1.42mm)
800' (244M)	#10 (2.95mm)	#14 (1.75mm)

- Maximum Antenna Size
  A. Tower Mounted as per Figure 1 - 15 square feet (1.4M²) of wind surface area.
  B. Outside Tower or Mast Mounted as per Figure 2 or 3 - 7.5 square feet (.67 M²) of wind surface area.
- Maximum Interconnect Cable Resistance:
  A. Terminals 1 and 2: .8 ohm
  B. Terminals 3,4,5,6,7, & 8: 2.0 Ohms
- Rotation Time: 45 - 60 seconds with 60 Hz input
- Brake: Positive, electrically operated wedge. 75 segments spaced 4.8° apart.
- Rotator size: 8 inches (20 cm) maximum diameter by 13.5 inches (34 cm) high.
- Maximum antenna mast size: 2-1/16" O.D. (52 mm).
- Mounting hardware: Stainless steel hardware and plated steel clamp plate.
- Control unit size: 8.5 inches (21.6 CM) wide x 9.0 inches.

  (22.8 CM) deep x 4.3 inches (11.0 CM) high.
- Shipping volume: 2,280 cu. in. (37,350 ccms).
- Shipping weight: 23.4 pounds (10.6 kg).

PARTS AND PRICE LIST

CONTROL UNIT

HAM IV/CD-45 (SERIES II)

PART NUMBER	DESCRIPTION	PRICE
51568-10	Control Unit, 120 VAC, Complete	$119.95
51436-10	Printed Circuit BD. Assy., Complete C-1 Capacitor 470 MFD 50V (1) R-1 Resistor 390 OHM 2W (1) VR-1 Diode, Zener (1) CR-1 Diode (1) R-2 Resistor 10 K OHM 1/4 W (1) F-2 Fuse 1/8 AMP (1)	20.00
51437-10	Expendable Parts Kit F-1 Fuse, 1/8 AMP (2) F-2 Fuse, 3 AMP (2) Bulb, Meter (2) - 28V@.1A #1819	3.00
51438-10	Switch Kit Switch, Snap Action Type, S-3, S-4, & S-5 (3)	7.00
51481-10	Cover Kit Cover, Top Cover, Bottom Screws (8) Skid Pads (4)	9.00
51482-10	Misscellaneous Hardware Kit Knob, On/OFF Switch (1) Knob, Calibration Switch (1) Terminal Board Assy. (8 terminals) and Screws (2) Lever, Switch (for S-3, S-4, & S-5) (3) 8-Wire Cable Strain Relief & Screw	4.00
51441-10	Transformer Kit (Power) 120 VAC	18.00
51442-10	Transformer Kit (Meter) 120 VAC	11.00
51172-10	Capacitor Kit Motor Start (C-2)	4.00
50861-10	Line Cord Kit, 3 wire	2.00
51499-10	Meter Kit Bulb Holder (1) Bezel (1) Mounting Hardware	27.00
51444-10	Switch Kit, on/off (S-1) For units with knob type switch	3.00
51776-10	Switch Kit, on/off (S-1) For units with paddle type switch	4.50
51445-10	Switch Kit, Calibration (S-2)	6.00
51446-10	Fuse Holder Kit, F-2	2.00
51570-10	Face Plate Kit	4.00
51448-10	Chassis Kit	10.00

*Note: 120 VAC control unit can be converted to 220 VAC by installation of the 220 VAC power and meter transformers.

51449-10 Transformer Kit (Power) 220 VAC	$29.90
51450-10 Transformer Kit (Meter) 220 VAC	$15.25

To order parts, remit check or money order for total parts cost plus $2.00 for postage and handling to: CORNELL-DUBLIER ELECTRONICS, Department "C", 118 E. Jones Street, Fuquay-Varina, North Carolina 27526.

PRICE SCHEDULE AS OF SEPTEMBER 1980

CDE reserves the right to change price at its option. Current prices may be obtained by calling or writing the factory. Please send self addressed stamped envelope.

motor cable	internal
1 blk	blk x2 + brn
2 wht	ycl lg
3 red	grn
4 brn	blu
5 ycl	org
6 blu	ycl sm
7 org	wht
8 grn	red

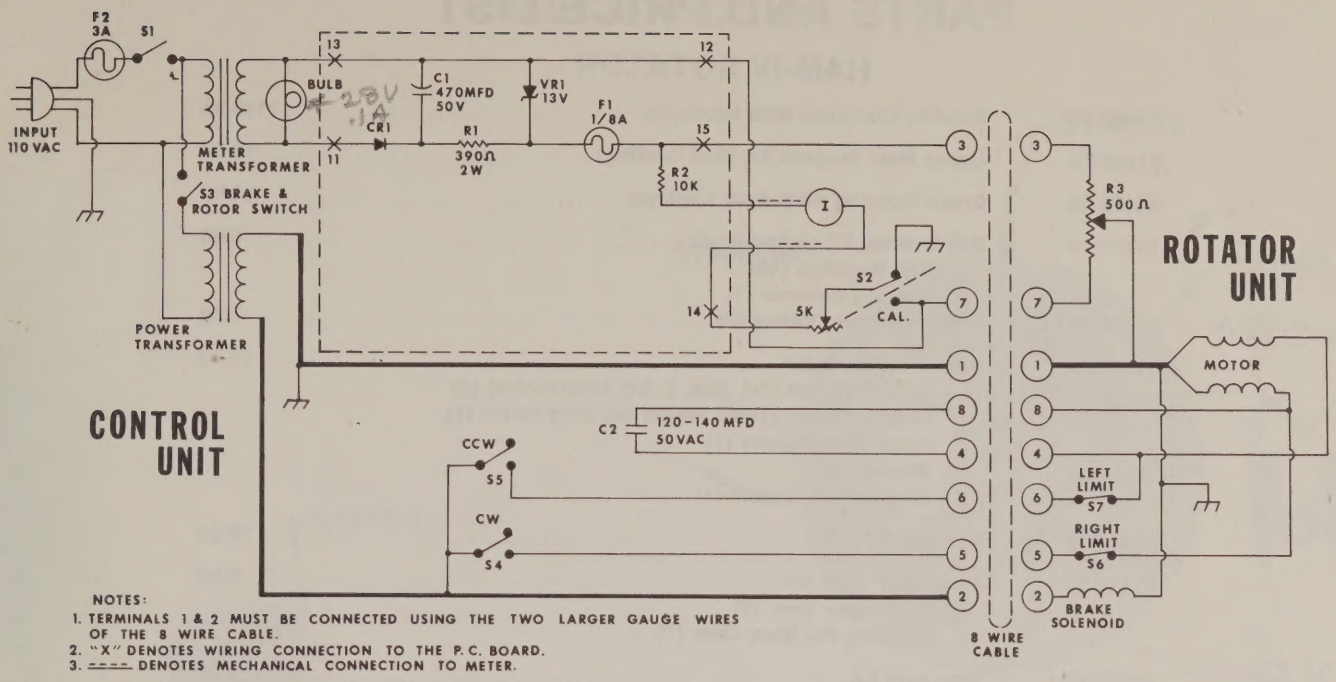
On 05/20/2015 08:03 AM, daniel herlihy w

> Take 180 east "King Canyon" to Academ
>
> Go past Ashlan then Gettysburg. Next s
> Turn right and turn right again at first d
> Shared drive I am on the left.

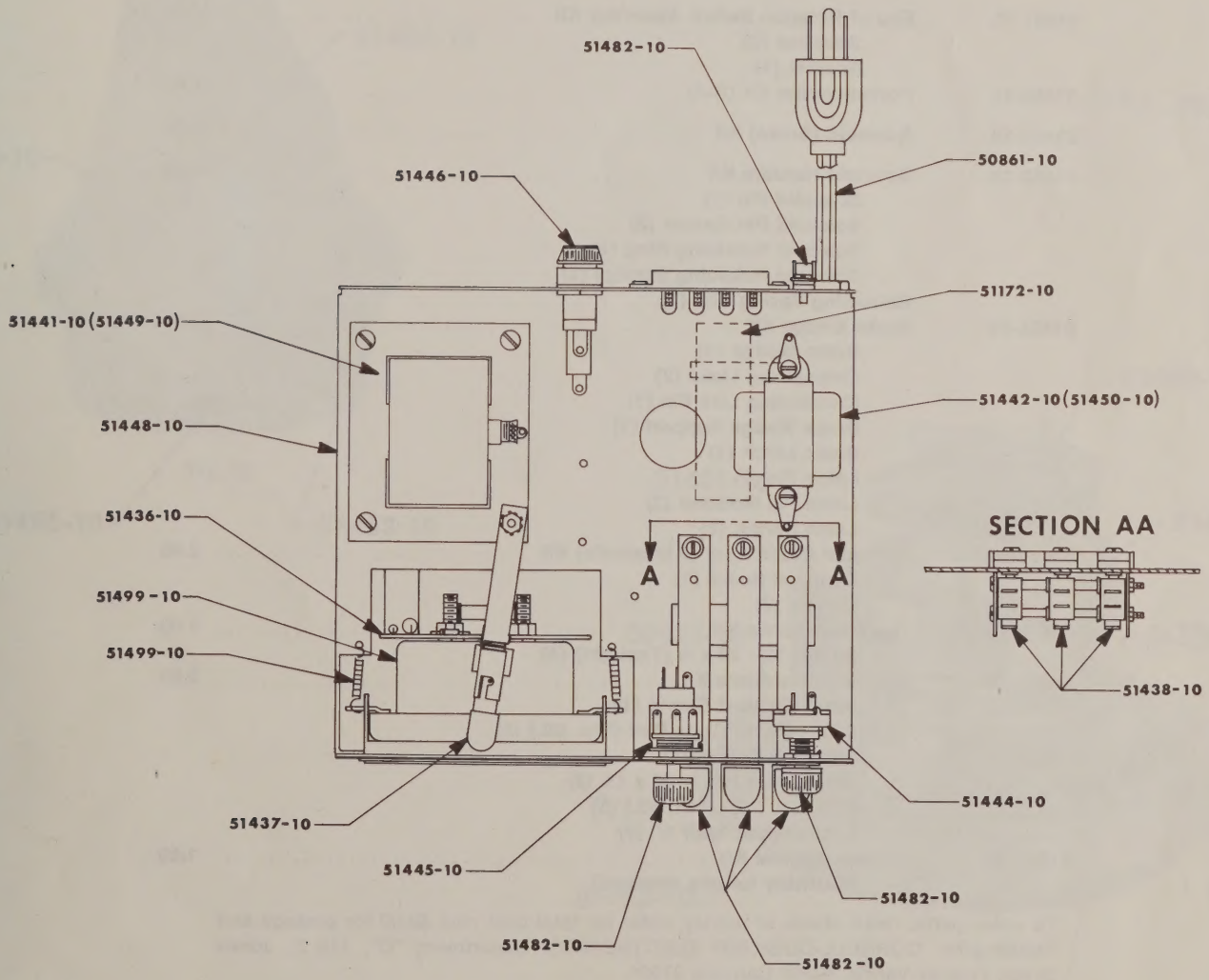
13143 E Rialto Ave

Norm's 866-701-5885
April 19th

1 Brake housing 501700
2 terminal strips
1 potentiometer
4 brake housing bolts stainless 2 3/4 x 1 1/4"
1 set bearings
4 6-32 x 3/8 Screws
4 6-32 x 3/8 SMS


F2
3A
S1
INPUT
110 VAC
METER
TRANSFORMER
BULB
28V
.1A
CR1
C1
470MFD
50V
VR1
13V
R1
390Ω
2W
F1
1/8A
R2
10K
S3 BRAKE &
ROTOR SWITCH
POWER
TRANSFORMER
CONTROL
UNIT
S2
5K
CAL.
C2
120-140 MFD
50VAC
CCW
S5
CW
S4
R3
500Ω
ROTATOR
UNIT
MOTOR
LEFT
LIMIT
S7
RIGHT
LIMIT
S6
BRAKE
SOLENOID
8 WIRE
CABLE
NOTES:
1. TERMINALS 1 & 2 MUST BE CONNECTED USING THE TWO LARGER GAUGE WIRES OF THE 8 WIRE CABLE.
2. "X" DENOTES WIRING CONNECTION TO THE P.C. BOARD.
3. ---- DENOTES MECHANICAL CONNECTION TO METER.

SERIES 1


51482-10
50861-10
51446-10
51172-10
51441-10(51449-10)
51442-10(51450-10)
51448-10
51436-10
SECTION AA
A
A
51499-10
51499-10
51438-10
51444-10
51437-10
51445-10
51482-10
51482-10
51482-10

PARTS AND PRICE LIST

HAM-IV ROTATOR

51569-10	Rotator, Complete With Hardware	$139.95
51452-10	Upper Mast Support Kit (Bell Casting)	12.00
51453-10	Brake Housing Kit (Lower Casting)	14.00
51454-10	Ball Bearing Kit (2-Required) Ball Bearings (49) Bearing Retainer (1)	8.00
5009701 51455-10	Brake Support Casting Kit	7.50
51456-10	Gear and Pinion Kit Gear & Pinion (1st, 2nd, & 3rd. from motor) (3) Gear & Pinion (Thick Pinion 4th from Motor (1) Small Gear Spacer (1) Washer (3) Larger Gear Spacer (1)	10.00
51494-10	Ring Gear Kit	12.00
51457-10	Final Spur Gear Kit Final Spur Gear (2) Bushing For Spur Gear (1)	9.50
50423-10	Stop Arm Kit	2.00
5037000 50370-10	Base Casting and Gear Shaft Assembly Kit	6.00
51459-10	Motor Mounting Plate Kit	5.00
51470-10	Motor and Pinion (Brass) Kit	25.00
51461-10	End of Rotation Switch Assembly Kit Switches (2) Bracket (1)	4.00
5023100 51460-10	Potentiometer Kit (R-3)	11.00
51462-10	Solenoid (Brake) Kit	10.00
51463-10	Solenoid Hardare Kit Solenoid Pin (1) Solenoid Pin Spacer (3) Solenoid Retaining Ring (2) Solenoid Retaining Springs (2) Retracting Spring Clip (2)	4.00
51464-10	Brake Wedge Kit Brake Wedge (1) Connecting Links (2) Connecting Link Pin (1) Brake Wedge Support (1) Brake Latch (1) Latch Pin (2) Latch Pin Retainer (2) Latch Spring (2)	12.00
51465-10	Terminal Board Assy (8 terminals) Kit Terminal Board (1) Screws (2)	2.00
5105700 51466-10	Hex Head Screw Kit Screw, 12 - 24 x ¾ (Taptight) (4)	1.00
51415-10	Mounting Hardware Kit 50115-00 Mast Clamp (1) 50382-00 "U" Type Bolt (Stn. Stl.) (2) 50502-00 Spacer (4) Screw, Hex Hd. ¼-20 x 1¼ (5) Hex Nut ¼-20 (Stn. Stl.) (5) Lockwasher, Split ¼" (9)	8.00
51497-10	Grease, Special Kit (Quantity for one overhaul)	1.00

To order parts, remit check or money order for total cost plus $2.00 for postage and handling to: CORNELL-DUBILIER ELECTRONICS, Department "C", 118 E. Jones Street, Fuquay-Varina, North Carolina 27526.

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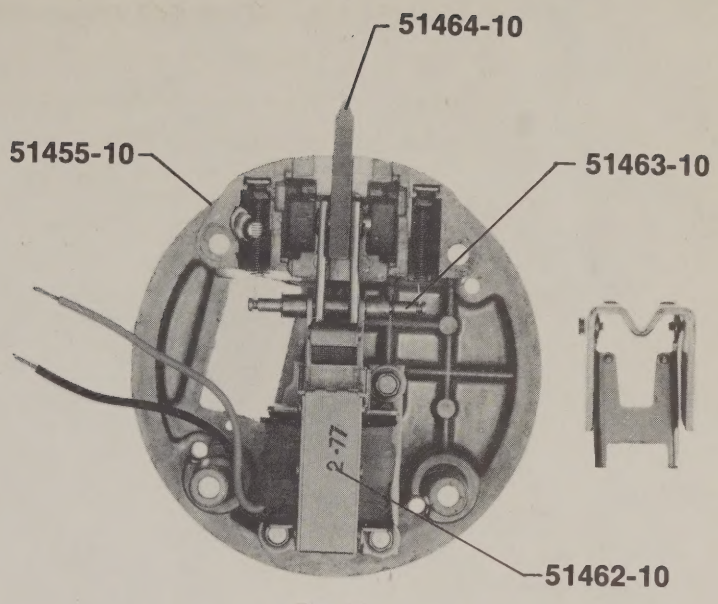


Fig. 11

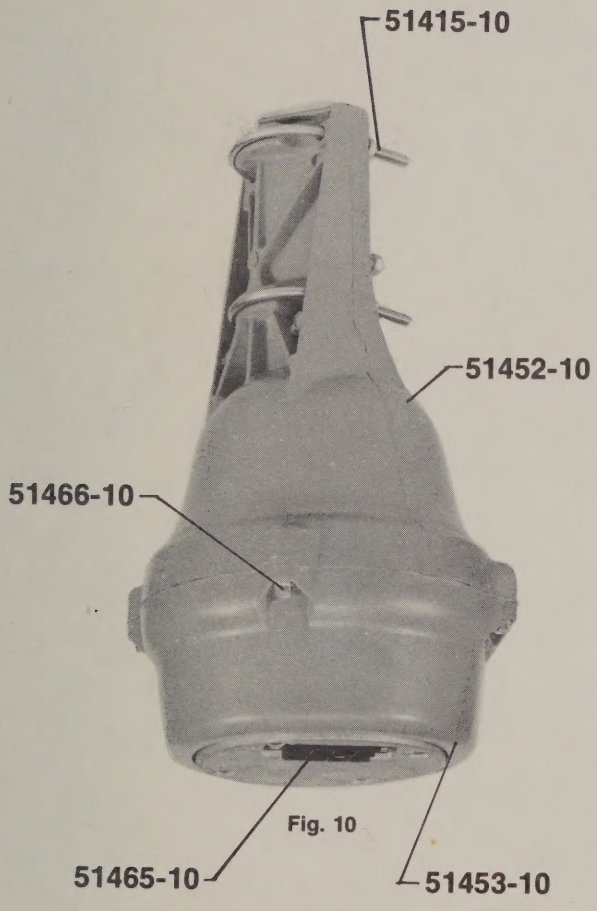


Fig. 10

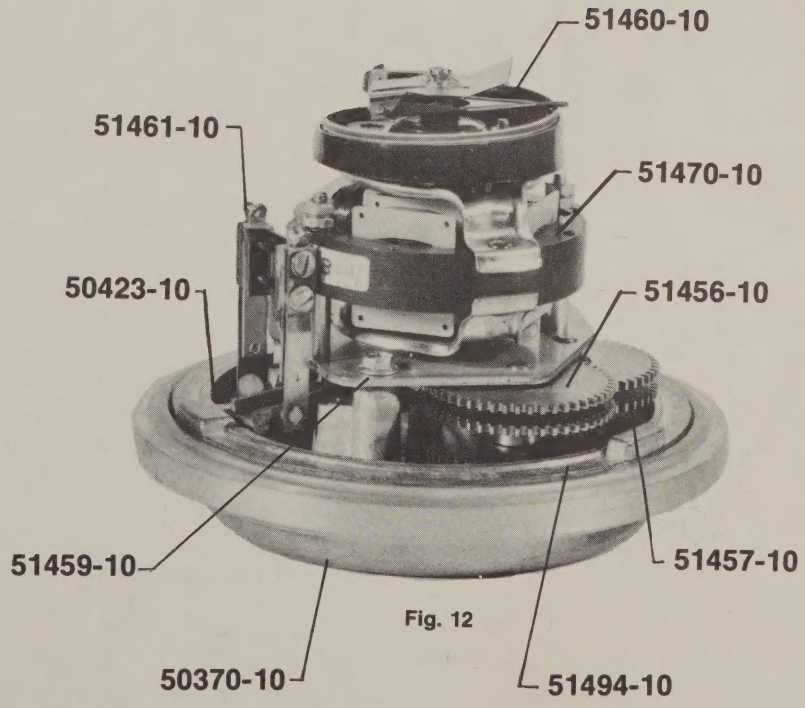
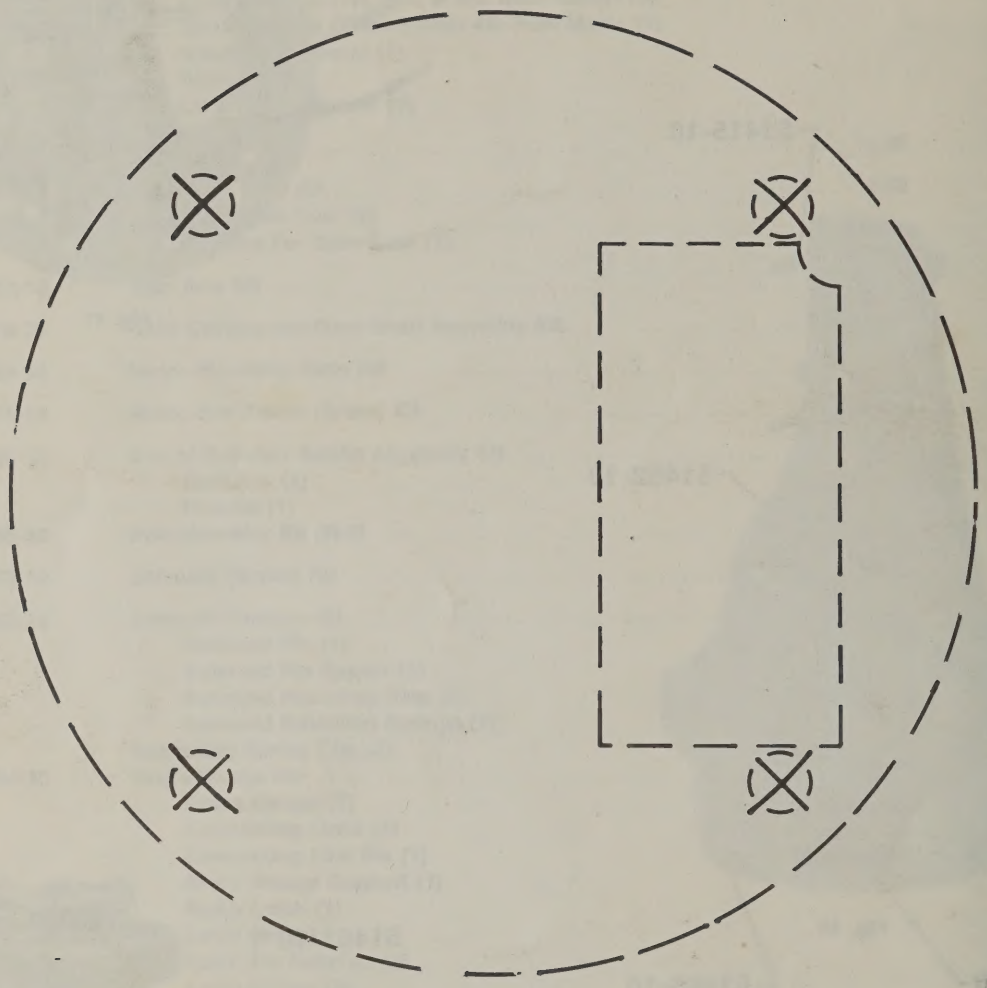


Fig. 12

HOLES TO BE 17/64 CLEARANCE DRILL



TOWER DRILLING TEMPLATE

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